

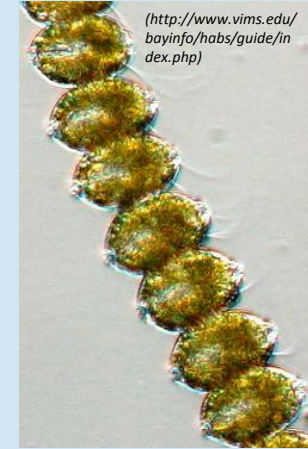
Spatial and temporal distribution of phycotoxins throughout lower Chesapeake Bay

Michelle D. Onofrio, Todd A. Egerton, Kimberly S. Reece, Sarah K.D. Pease, Caroline DeMent, Marta P. Sanderson, Bill Jones III, Allen R. Place, Evan Yeargan, Juliette L. Smith

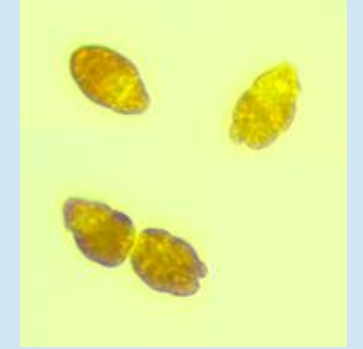


HAB species in Chesapeake Bay

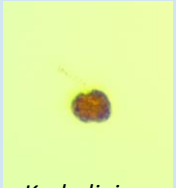
- Bloom forming species
 - *Margalefidinium polykrikoides* – unidentified
 - *Alexandrium monilatum* – **goniodomin A**
 - *Chattonella subsalsa* – **brevetoxin-like compounds**
 - *Karlodinium veneficum* – **karlotoxins**
 - *Microcystis* spp. – **microcystins**
- Non-bloom forming species
 - *Dinophysis* spp. – **okadaic acid, dinophysistoxins, pectenotoxins**
 - *Pseudo-nitzschia* spp. – **domoic acid**
 - Others??



Alexandrium monilatum



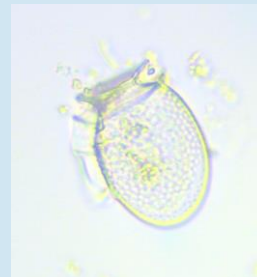
Margalefidinium polykrikoides



Karlodinium veneficum



Chattonella subsalsa



Dinophysis acuminata



Pseudo-nitzschia pungens

CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements



CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements

1. Conduct field study
(Apr. 2017-Jun. 2018)



CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements

1. Conduct field study
(Apr. 2017-Jun. 2018)
2. Develop multi-toxin UPLC-MS/MS quantification method
(Jan. 2018 – Jan. 2019)



CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements

1. Conduct field study
(Apr. 2017-Jun. 2018)
2. Develop multi-toxin UPLC-MS/MS quantification method
(Jan. 2018 – Jan. 2019)
3. Develop bulk, multi-toxin SPATT extraction method
(Jun. 2018 – Feb. 2019)



CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements



1. Conduct field study
(Apr. 2017-Jun. 2018)
2. Develop multi-toxin UPLC-MS/MS quantification method
(Jan. 2018 – Jan. 2019)
3. Develop bulk, multi-toxin SPATT extraction method
(Jun. 2018 – Feb. 2019)
4. Data analysis
(Jun. 2019 – Feb. 2020)

CBTOX

Goal: Understand spatiotemporal distribution of algal toxins and corresponding cells in lower Chesapeake Bay

- Solid Phase Adsorption Toxin Tracking (SPATT)
 - Passive sampling – relative toxin measurements

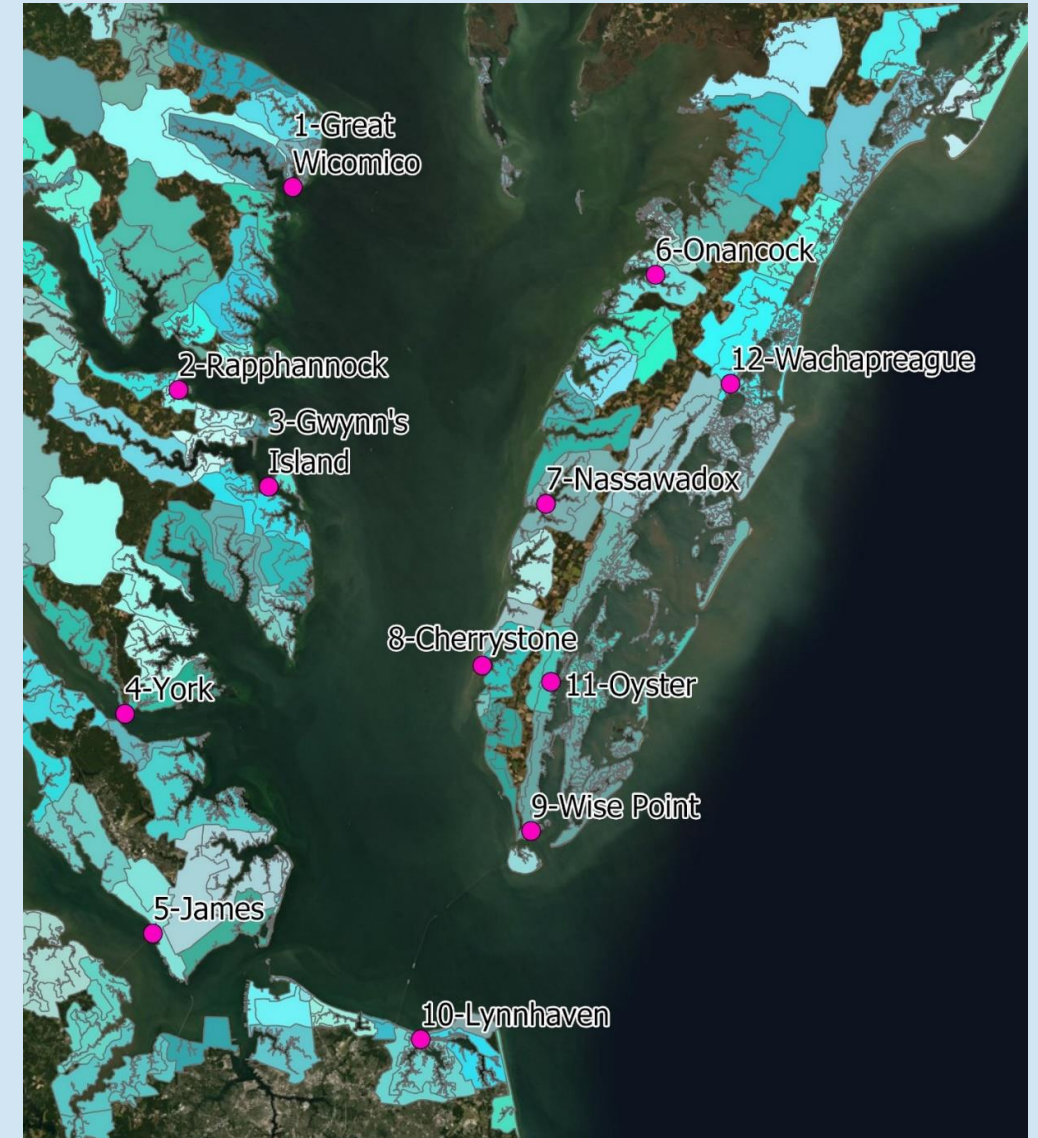


1. Conduct field study
(Apr. 2017-Jun. 2018)
2. Develop multi-toxin UPLC-MS/MS quantification method
(Jan. 2018 – Jan. 2019)
3. Develop bulk, multi-toxin SPATT extraction method
(Jun. 2018 – Feb. 2019)
4. Data analysis
(Jun. 2019 – Feb. 2020)

Methods – Field Study

12 sites sampled biweekly

- May 2017 - June 2018
- Tributaries, bayside Eastern Shore, seaside Eastern Shore

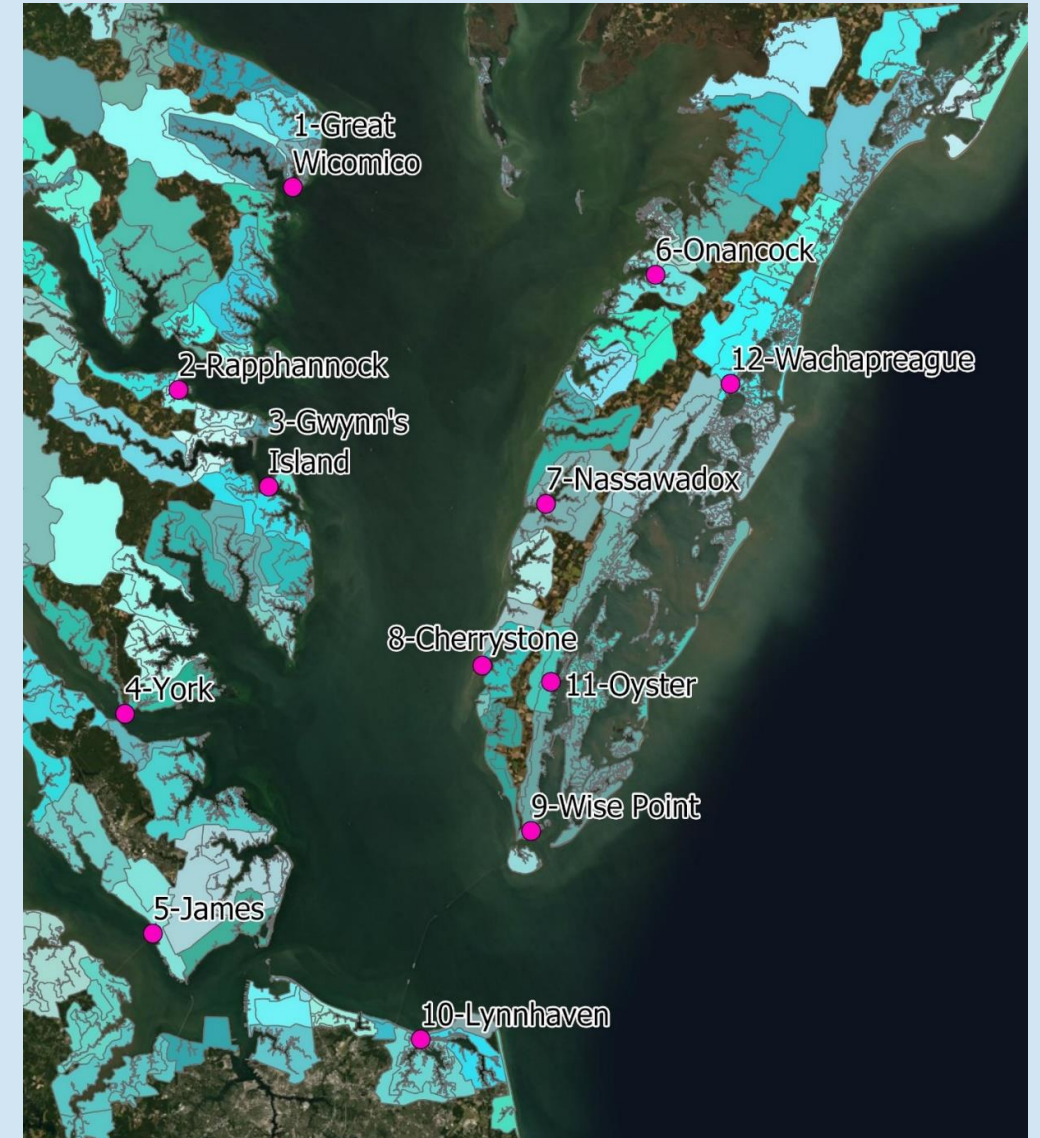


Methods – Field Study

12 sites sampled biweekly

- May 2017 - June 2018
- Tributaries, bayside Eastern Shore, seaside Eastern Shore

SPATT samples



Methods – Field Study

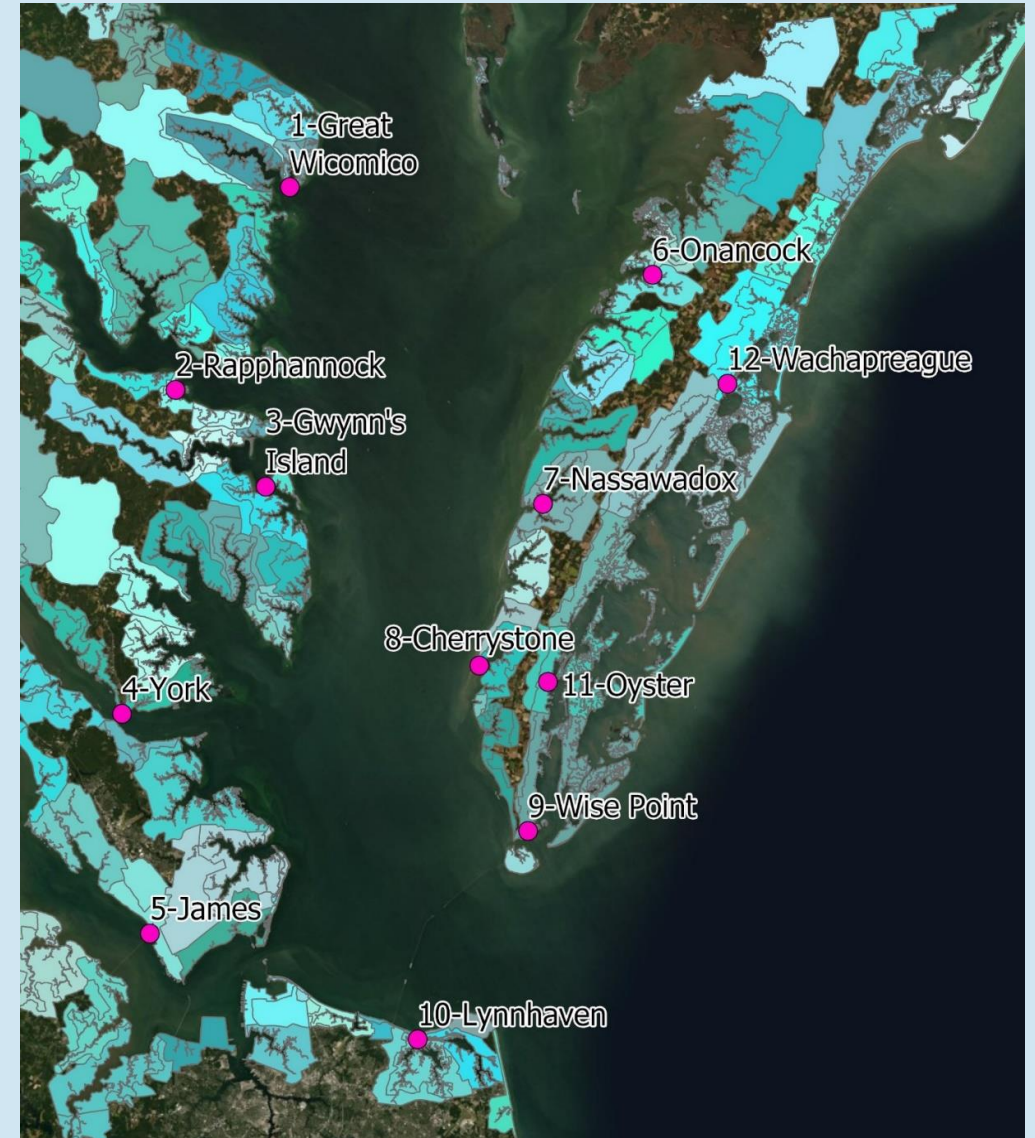
12 sites sampled biweekly

- May 2017 - June 2018
- Tributaries, bayside Eastern Shore, seaside Eastern Shore

SPATT samples

Whole water surface samples

- Cell ID by microscopy



Methods – Field Study

12 sites sampled biweekly

- May 2017 - June 2018
- Tributaries, bayside Eastern Shore, seaside Eastern Shore

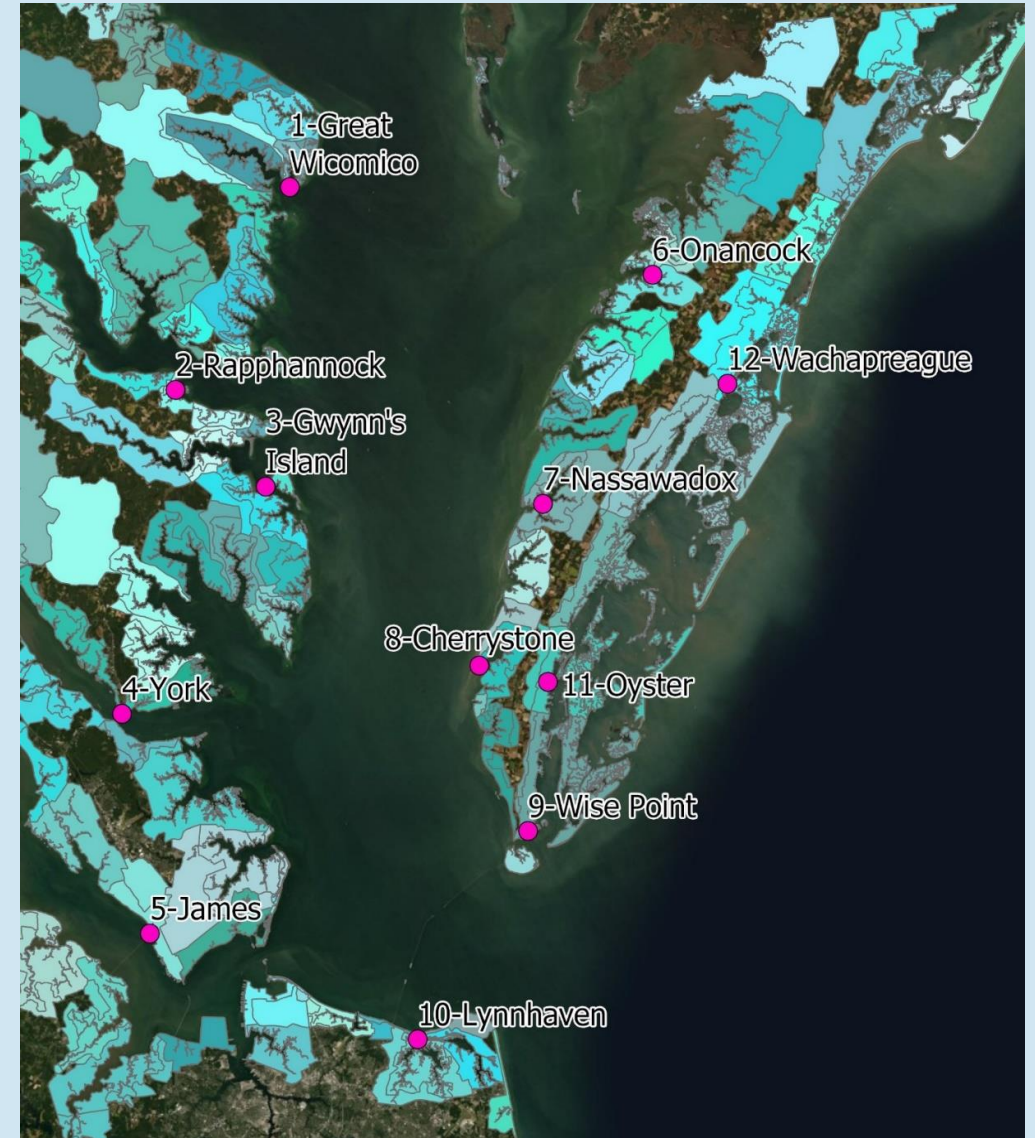
SPATT samples

Whole water surface samples

- Cell ID by microscopy



**other samples



Within ALL sites...

Toxins detected:

- OA
- DTX1
- PTX2
- GDA
- AZA1
- AZA2
- MC-LR
- DA

Within ALL sites...

Toxins detected:

- OA
- DTX1
- PTX2
- GDA
- AZA1
- AZA2
- MC-LR
- DA

Toxins not detected:

- DTX2
- MC-YR
- MC-RR
- YTX
- KmTx 1
- KmTx 3
- PbTx-2

Within ALL sites...

Toxins detected:

- OA
- DTX1
- PTX2
- GDA
- AZA1
- AZA2
- MC-LR
- DA

Toxins not detected:

- DTX2
- MC-YR
- MC-RR
- YTX
- KmTx 1
- KmTx 3
- PbTx-2

Overall trends:

OA, DTX1, PTX2 always detectable

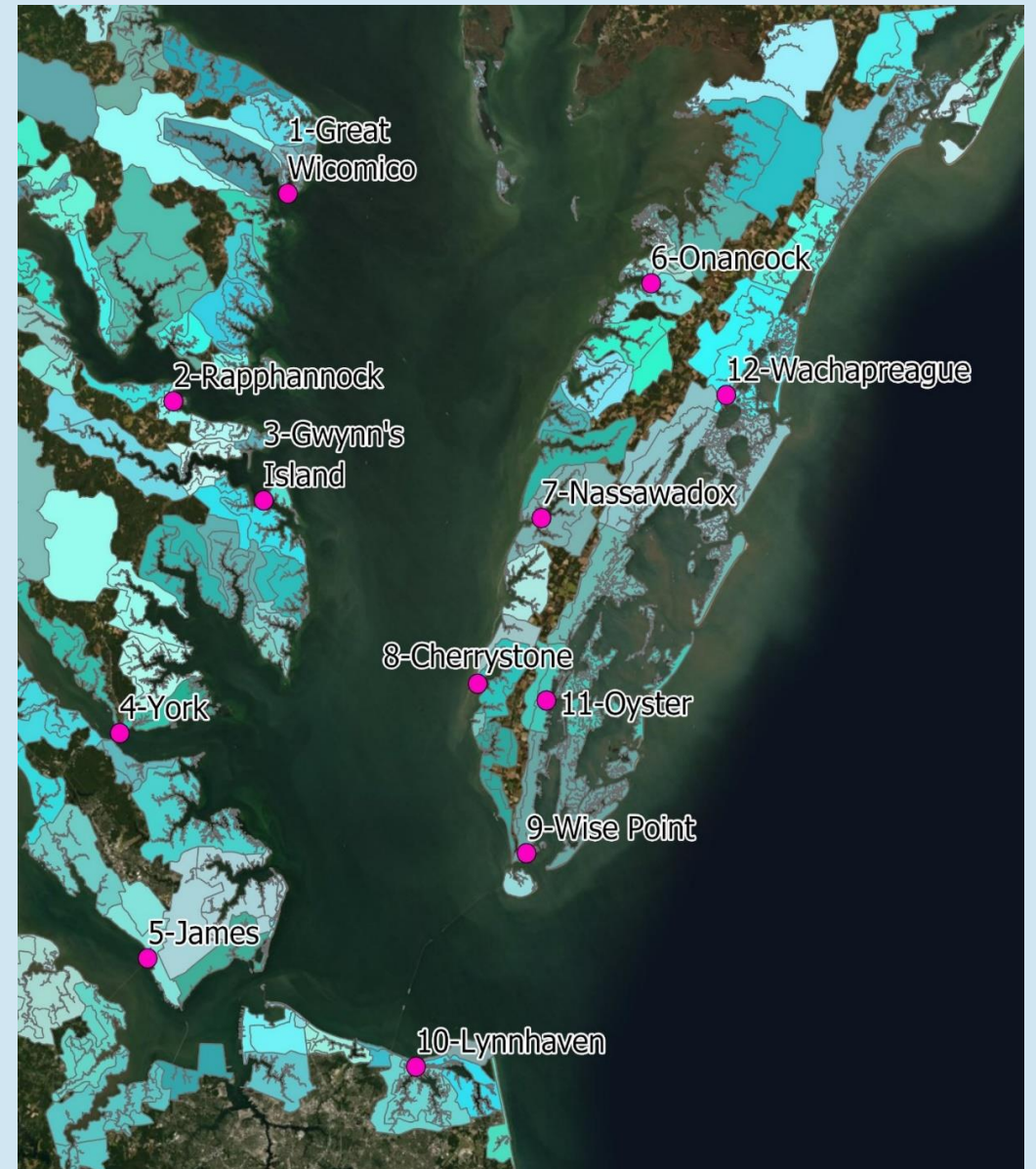
Among the first reports of AZA1 and AZA2 in Chesapeake Bay/US waters

- Low concentrations

Among the first reports of DA in Chesapeake Bay waters

Results: Spatial and temporal distribution

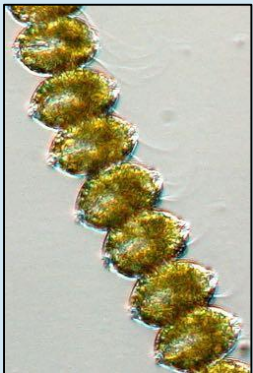
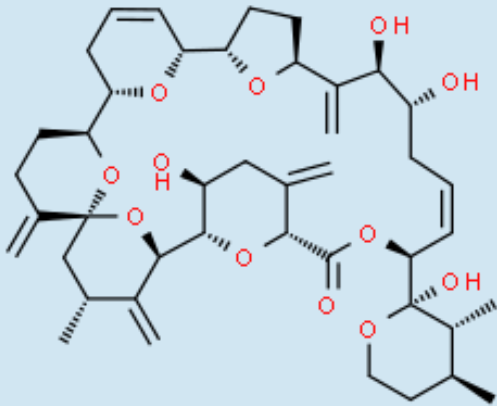
Toxin presence
indicated by



GDA

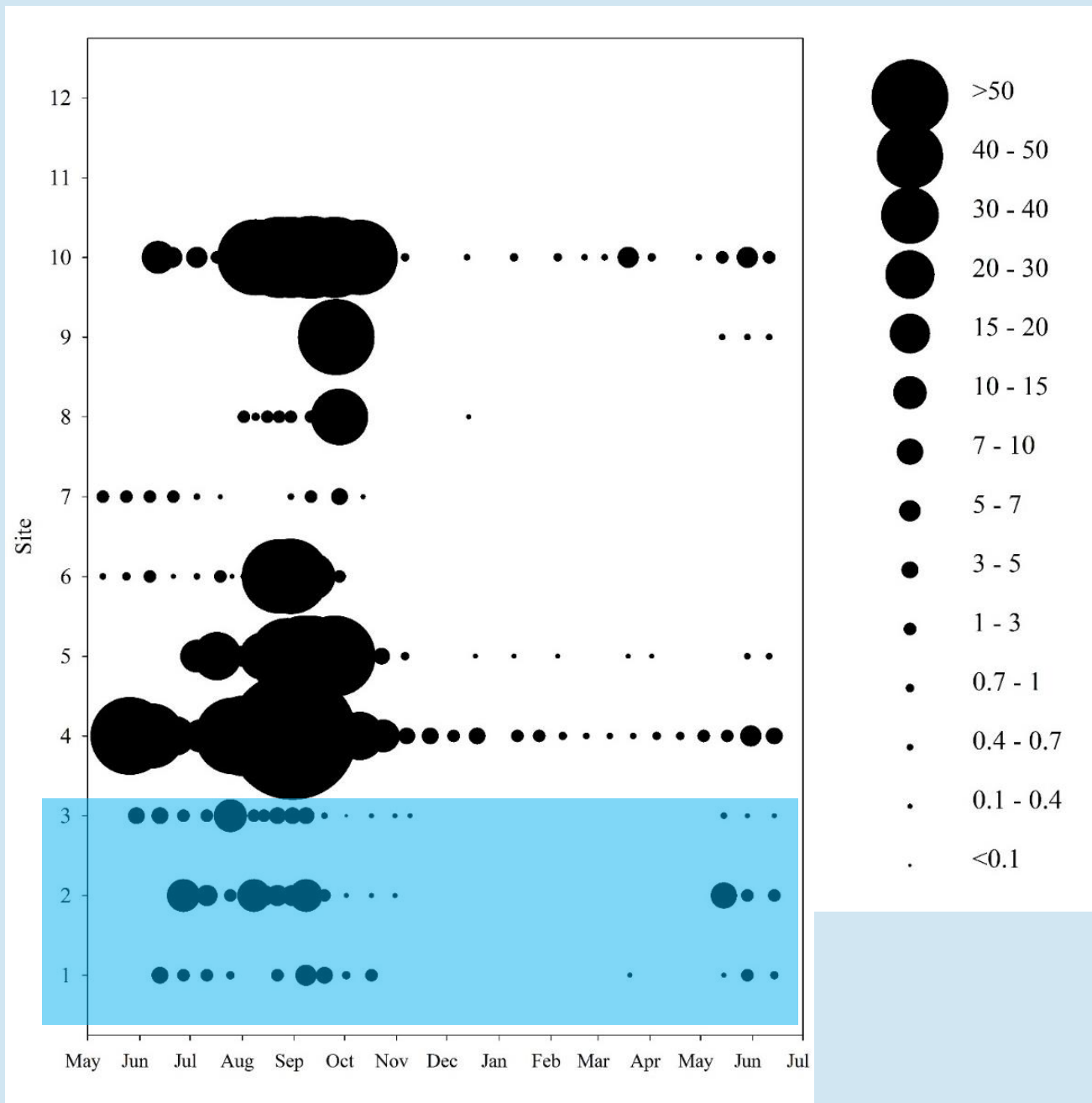
Alexandrium monilatum

Ichthyotoxic

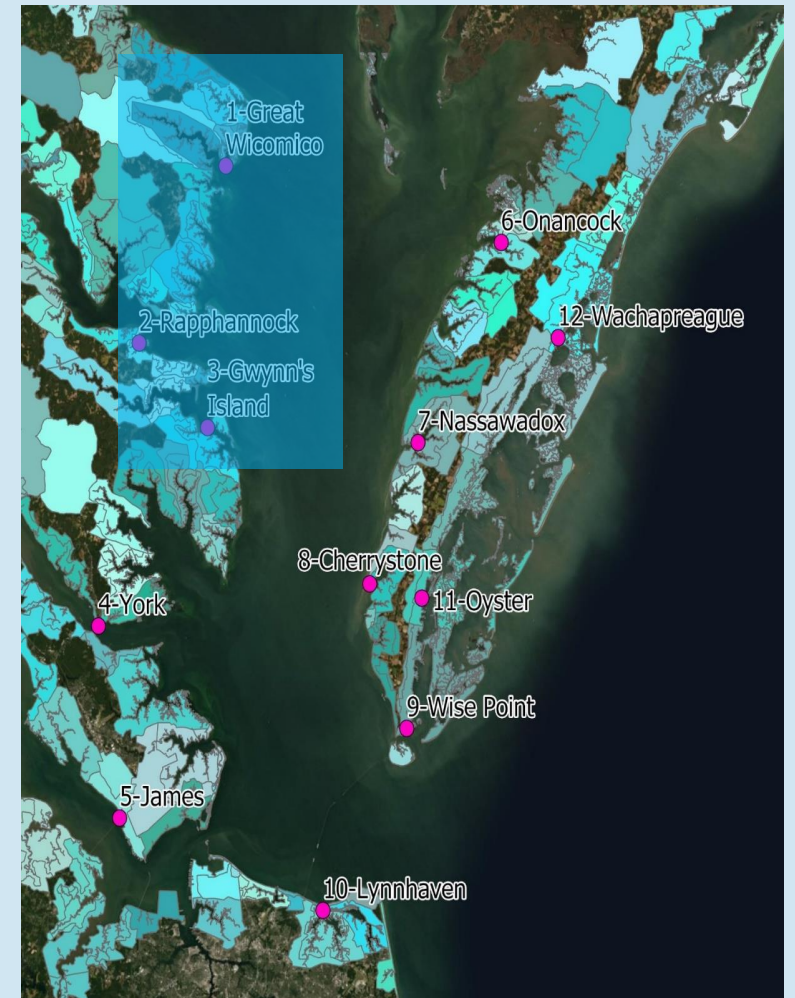


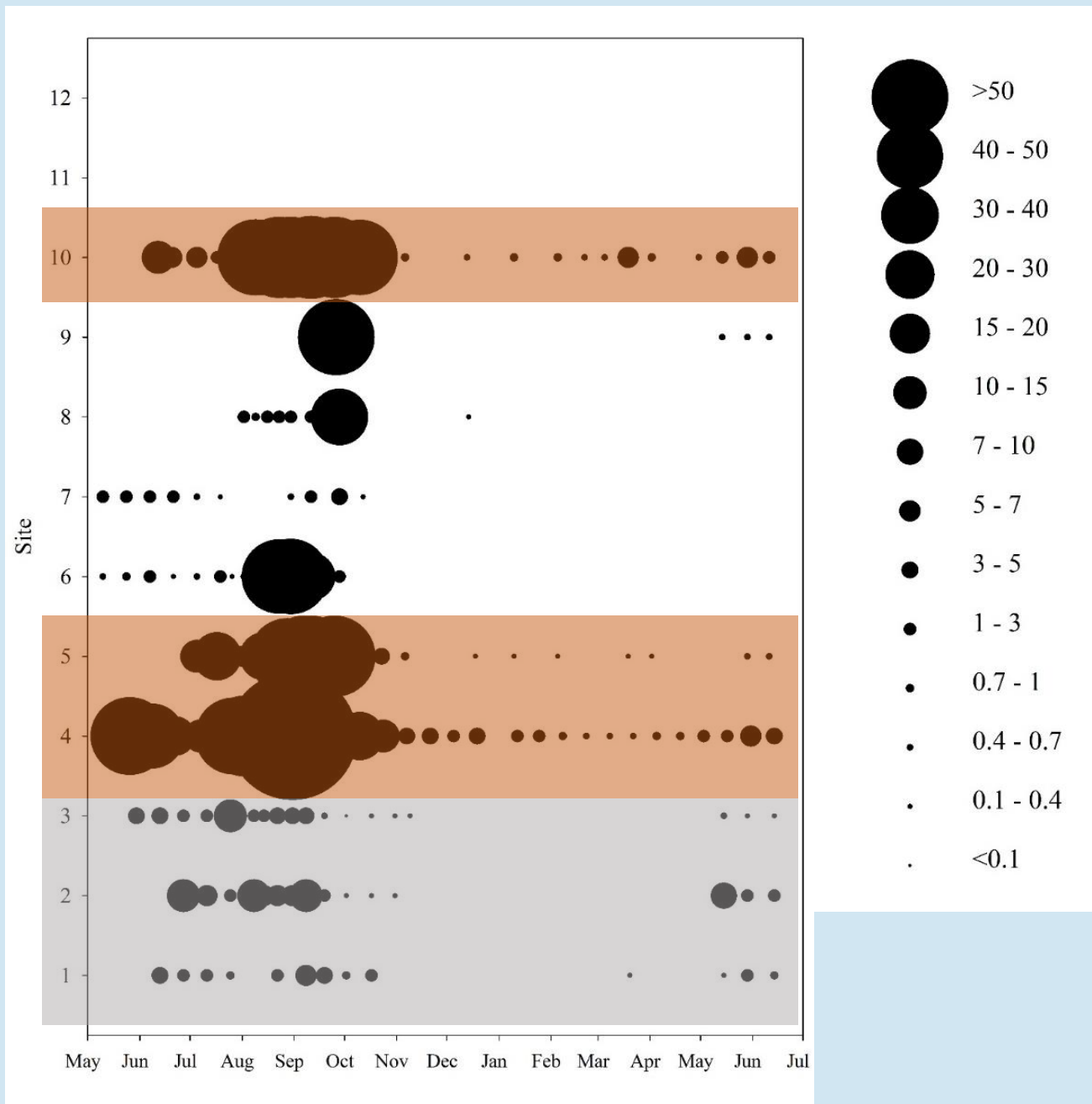
Alexandrium monilatum



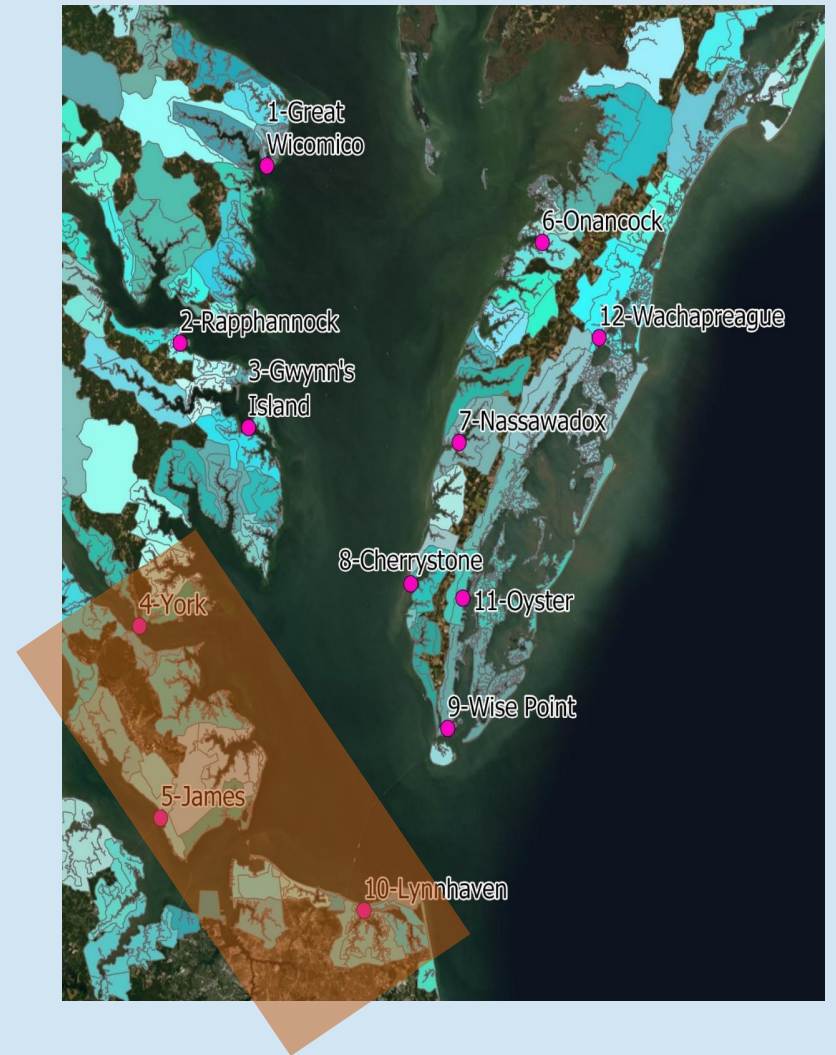


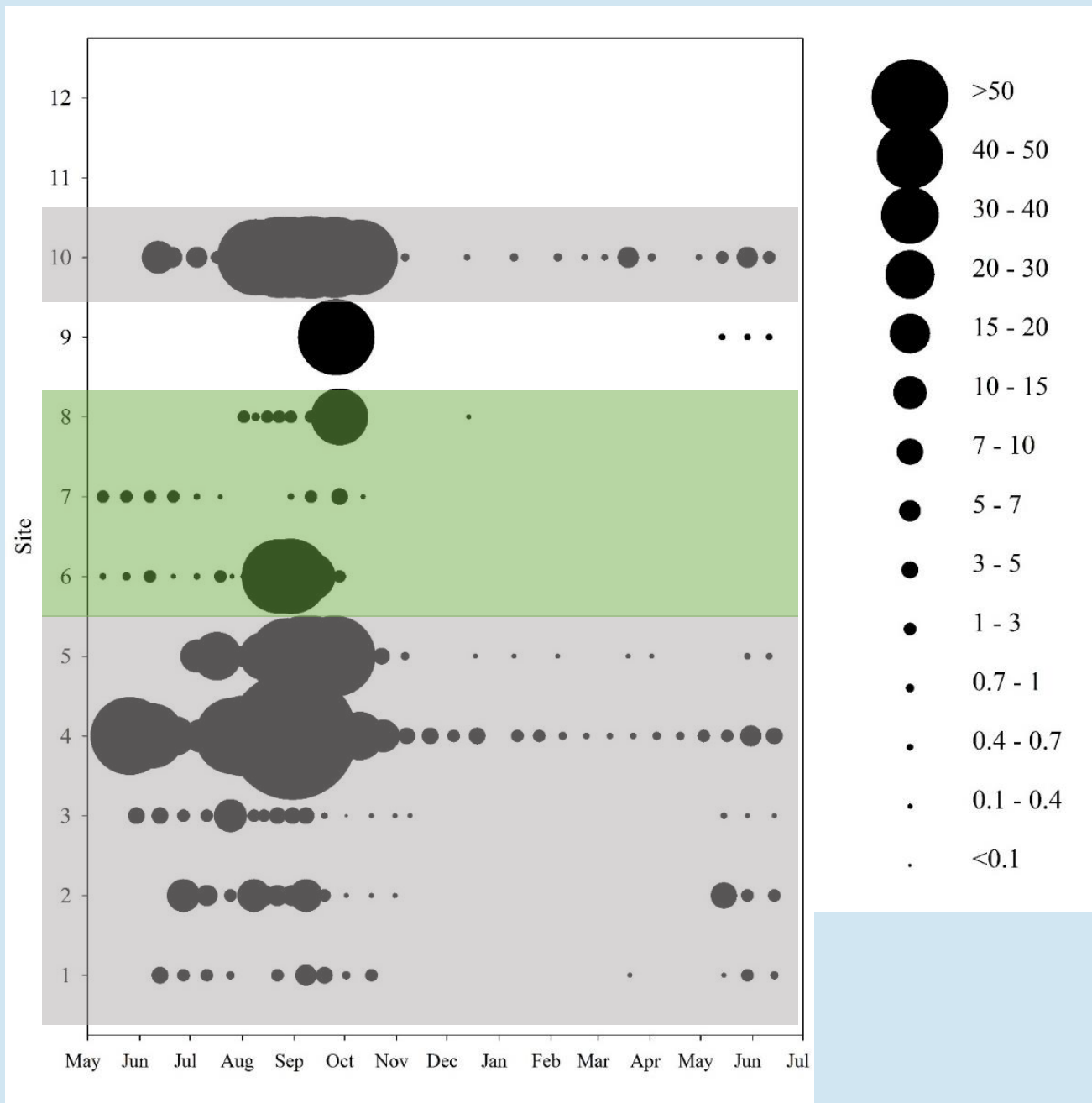
GDA



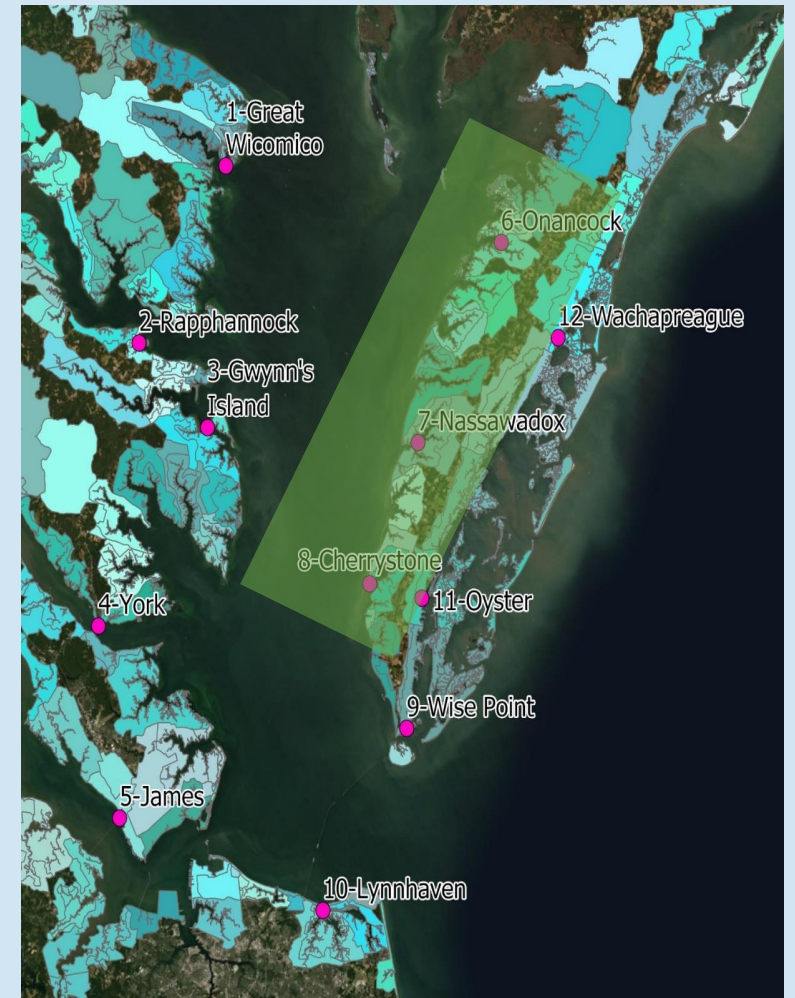


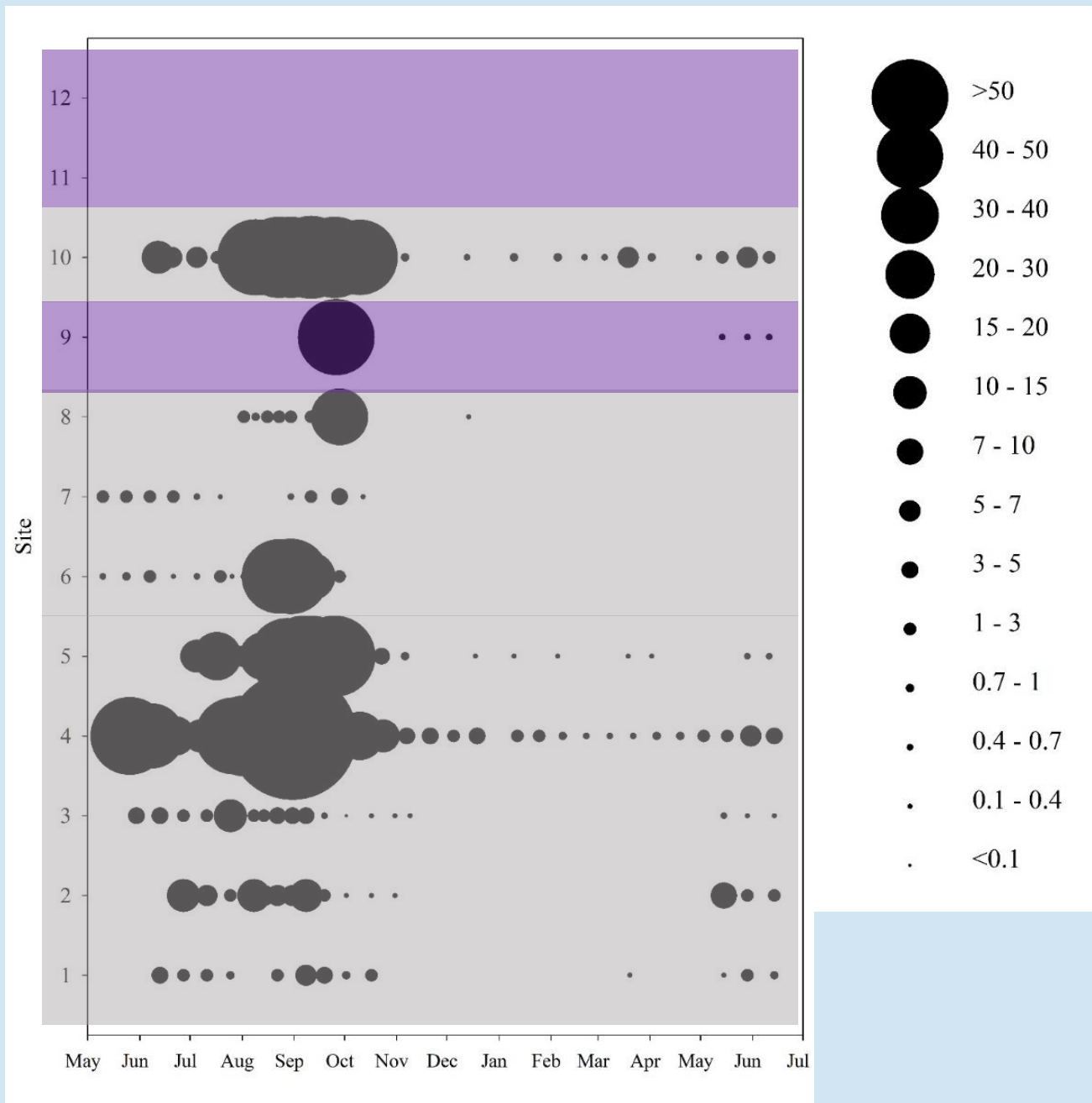
GDA



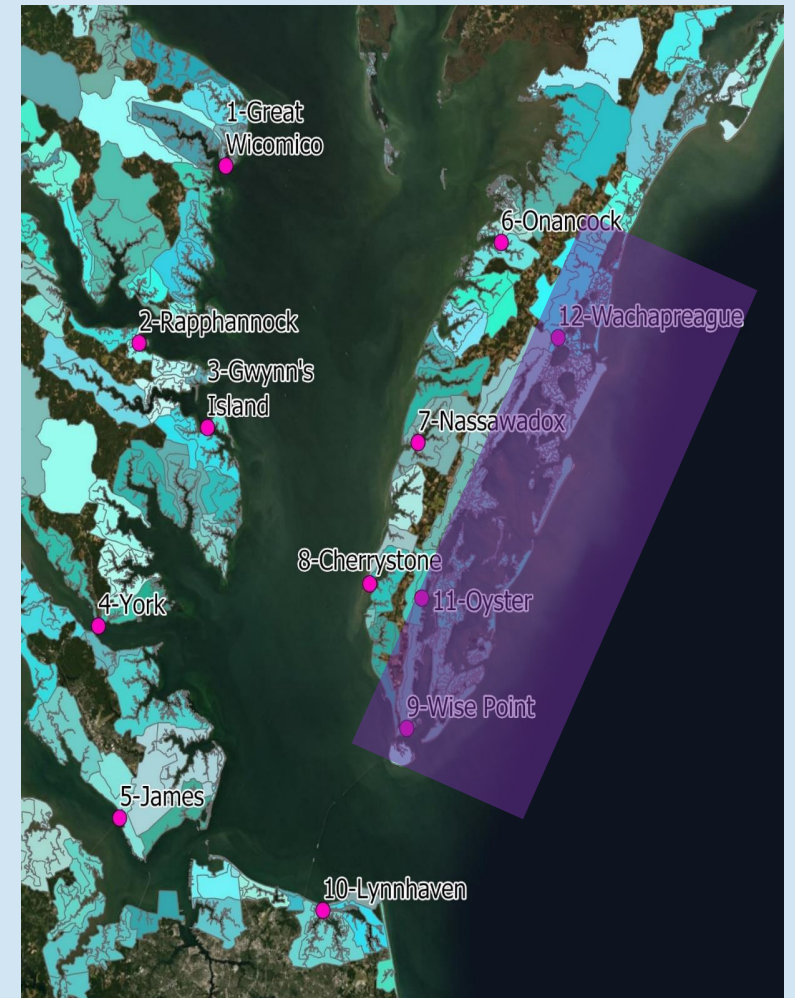


GDA

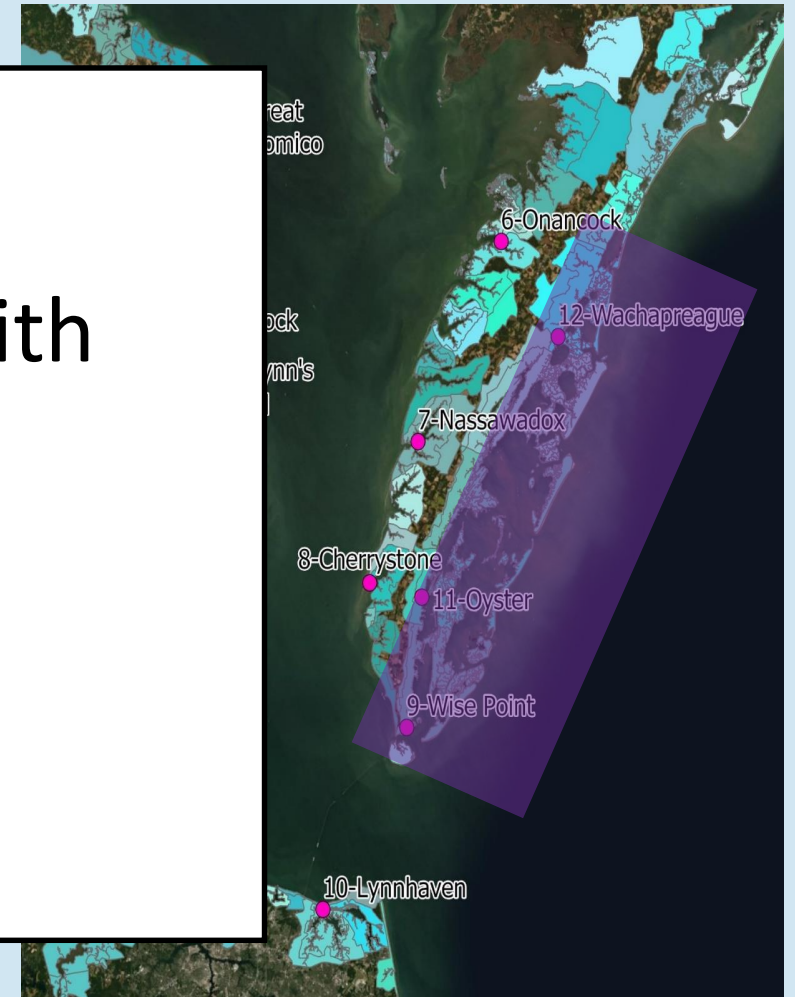
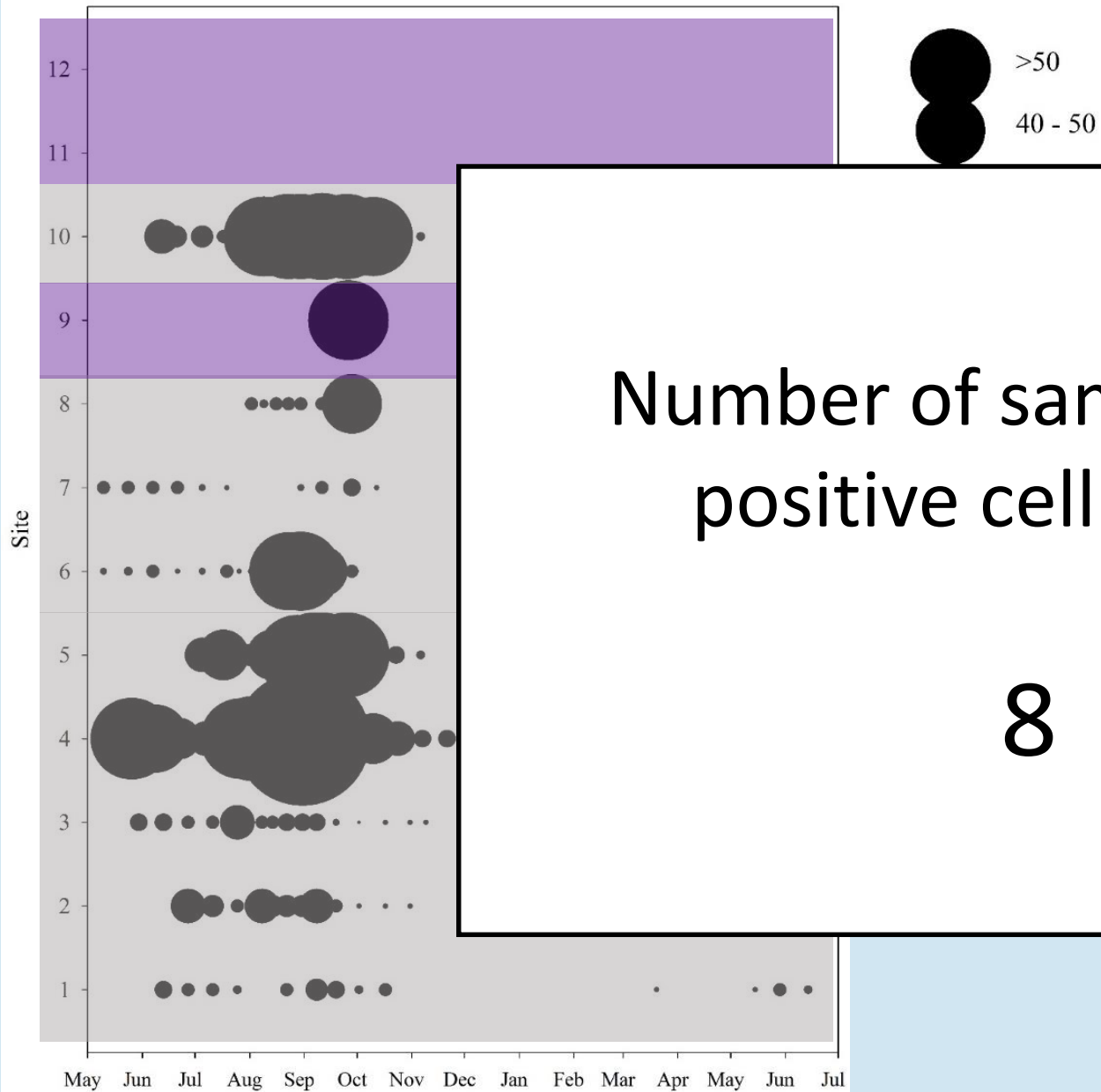




GDA



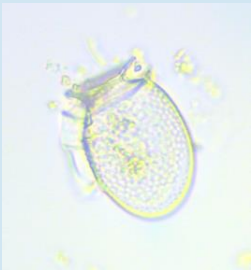
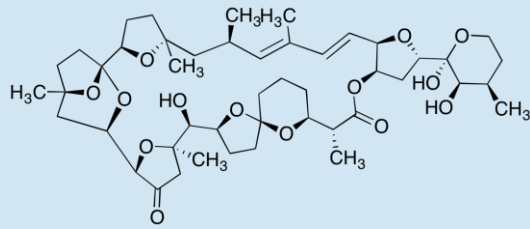
GDA



PTX2

Dinophysis spp.

Regulated in EU (toxicity?)



Dinophysis acuminata

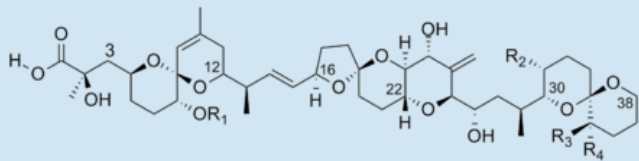


OA, DTX1

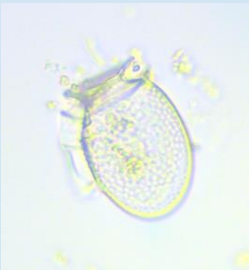
Dinophysis spp.

Prorocentrum lima

Diarrhetic Shellfish Poisoning



OA: R₁=H R₂=CH₃ R₃=H R₄=H
DTX-1: R₁=H R₂=CH₃ R₃=CH₃ R₄=H
DTX-2: R₁=H R₂=H R₃=H R₄=CH₃

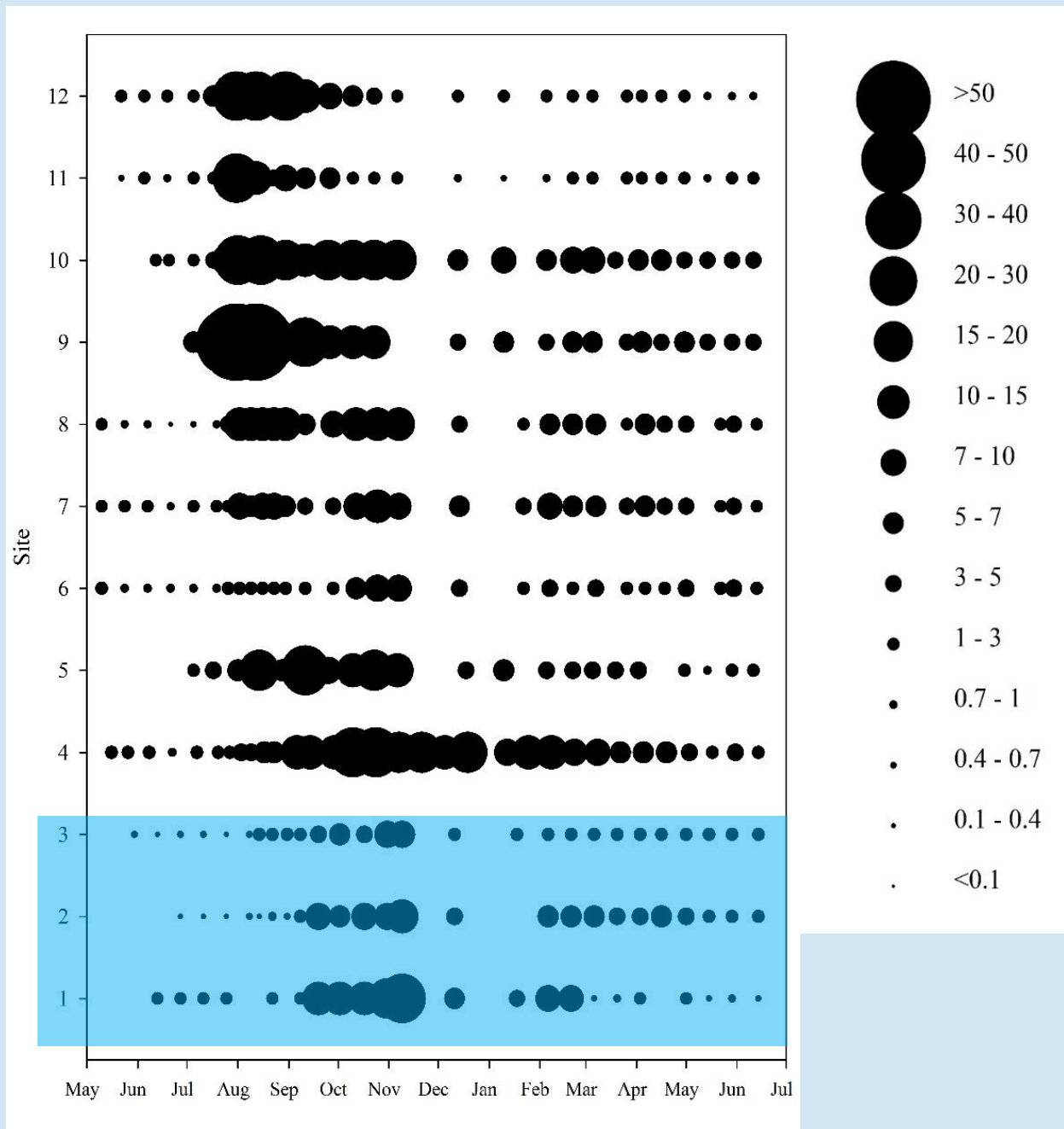


Dinophysis acuminata

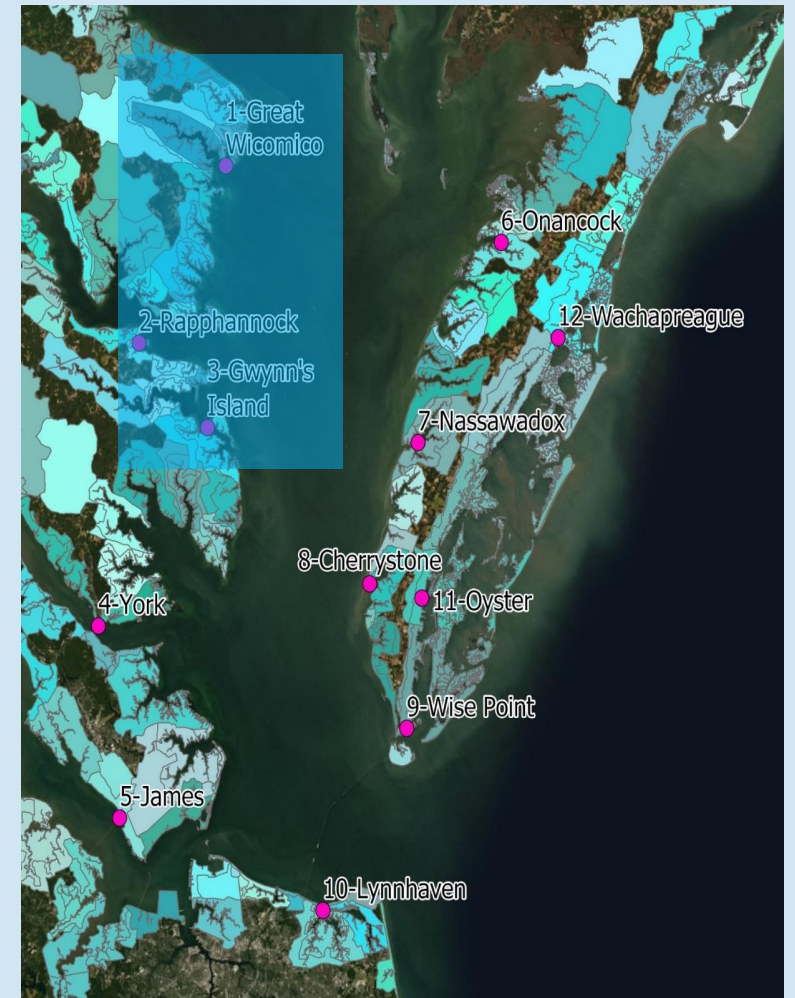


Prorocentrum lima

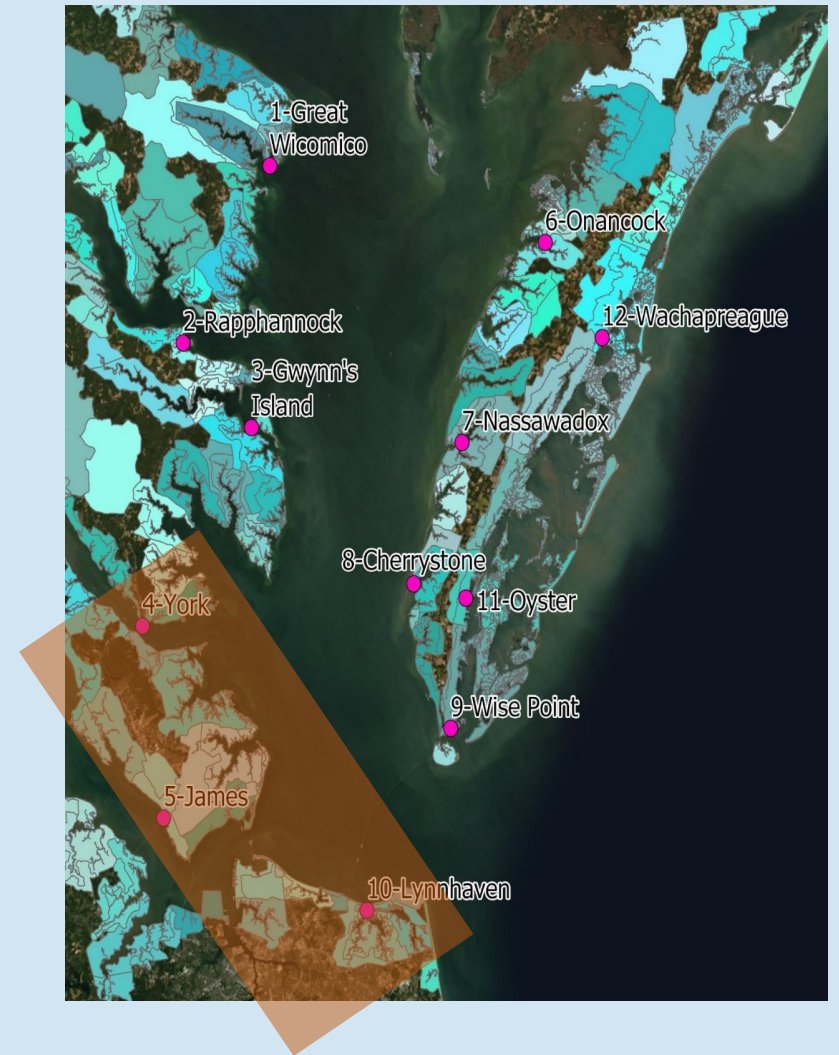
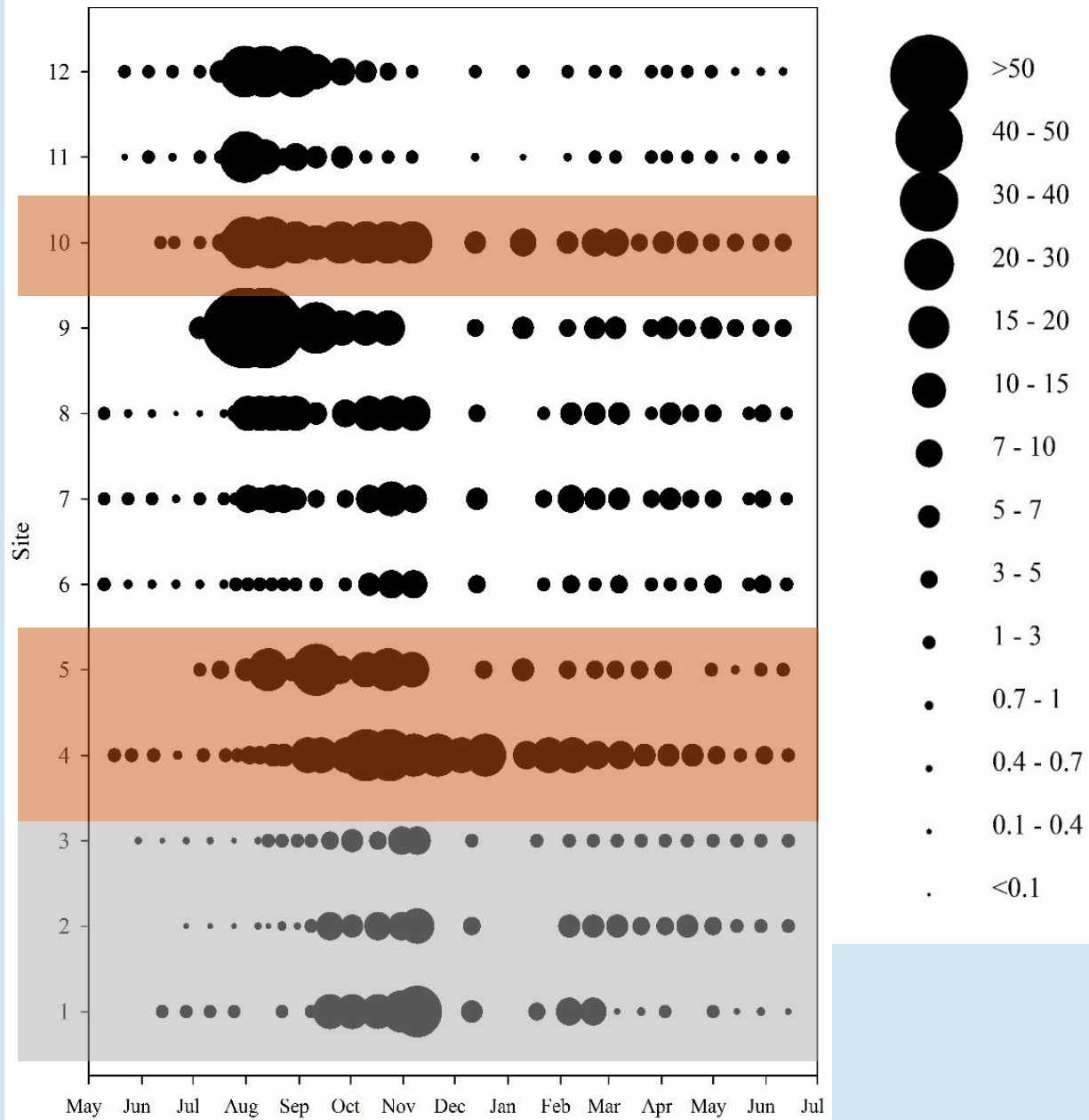


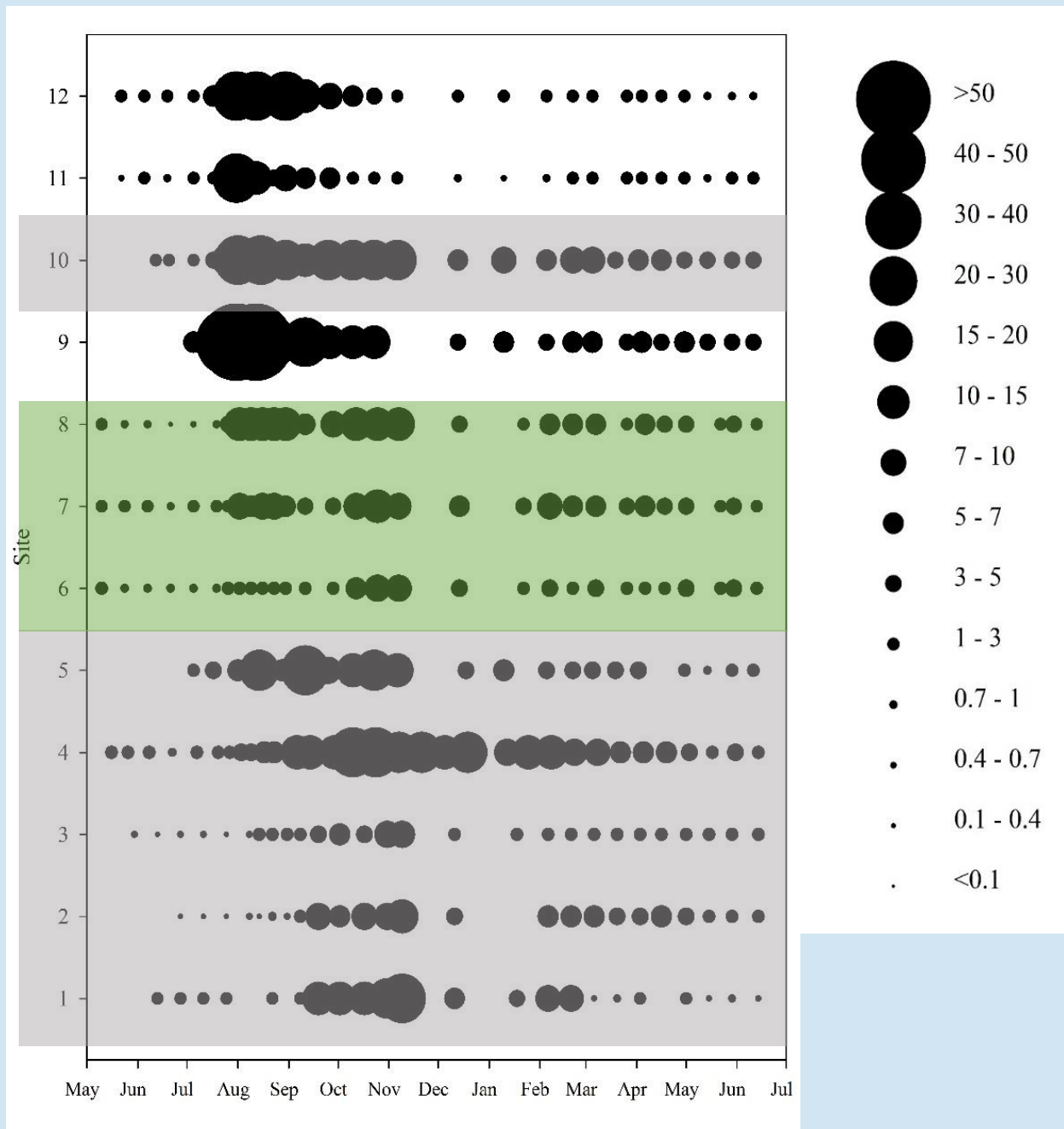


OA

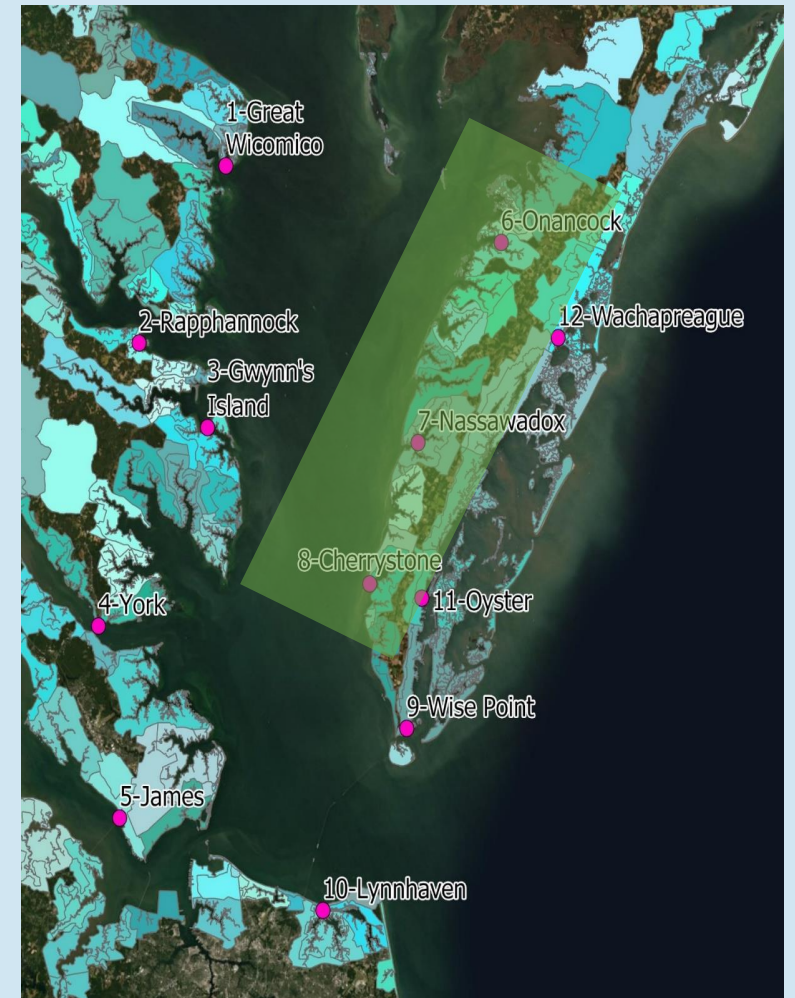


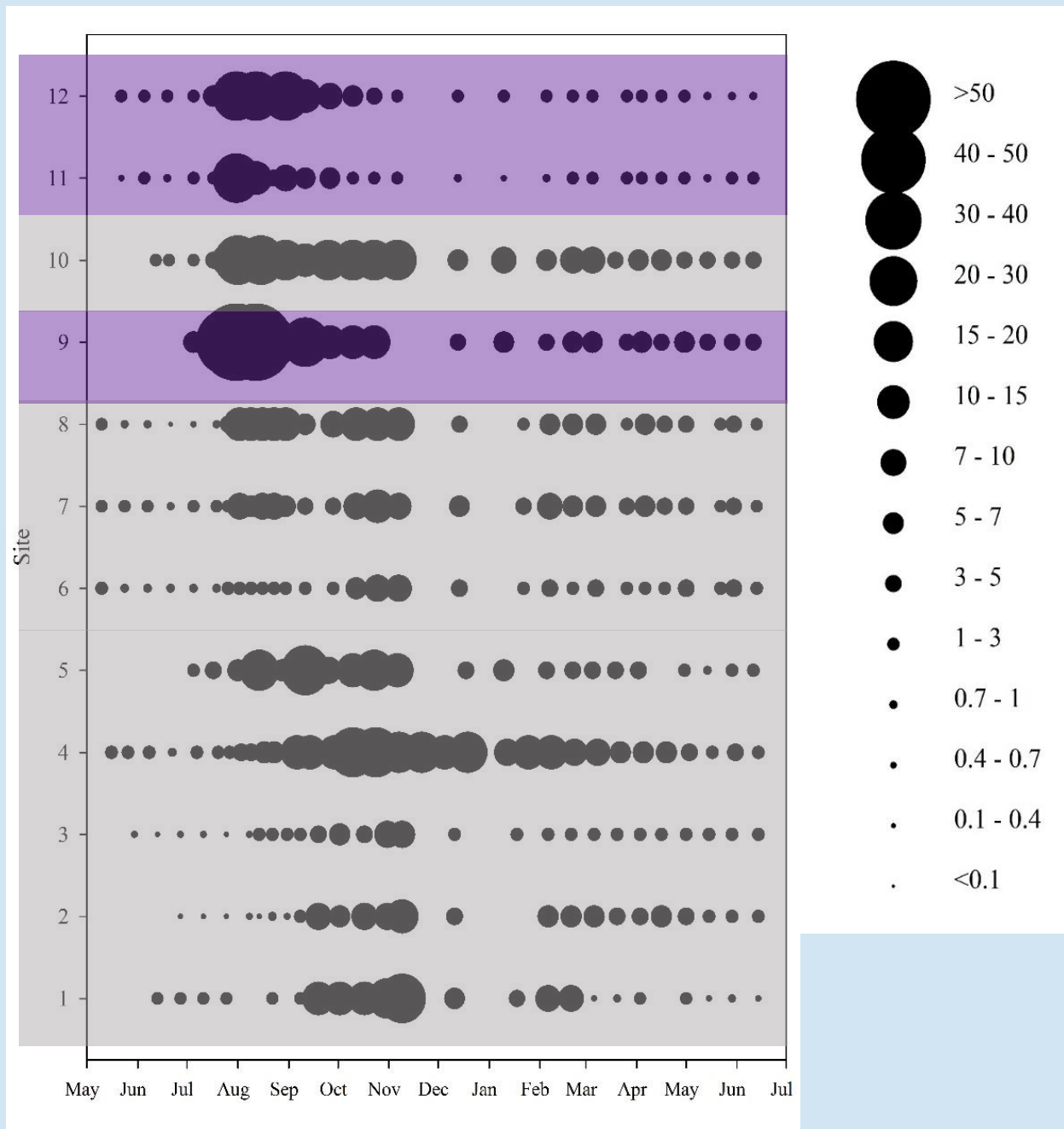
OA



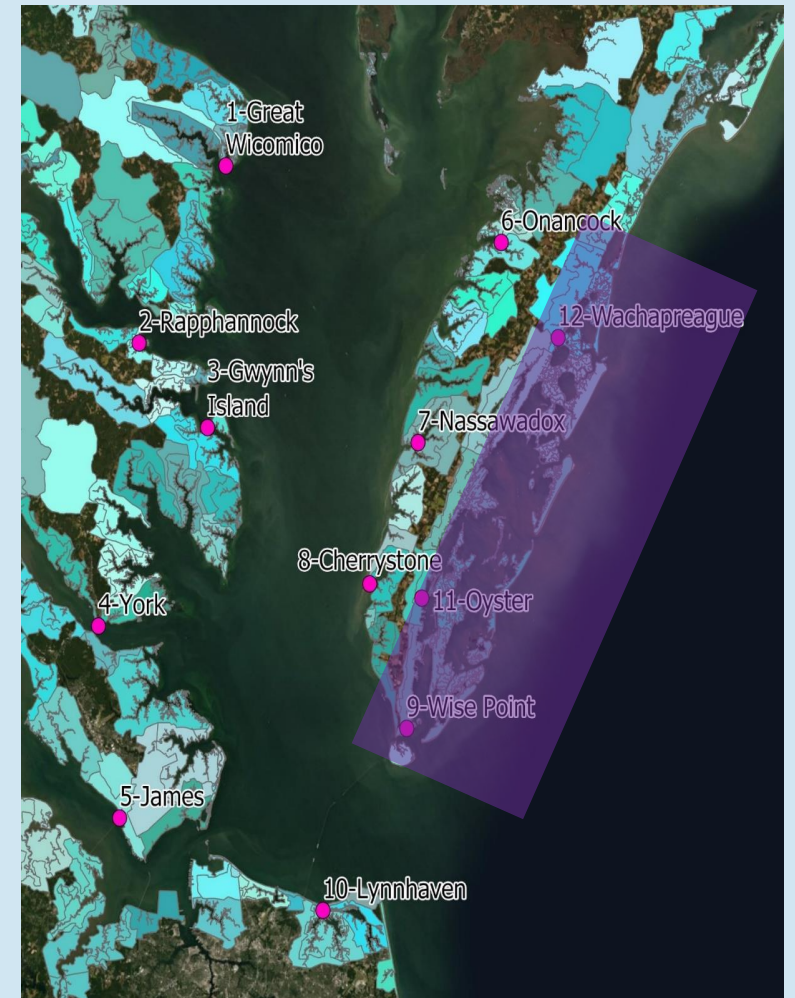


OA

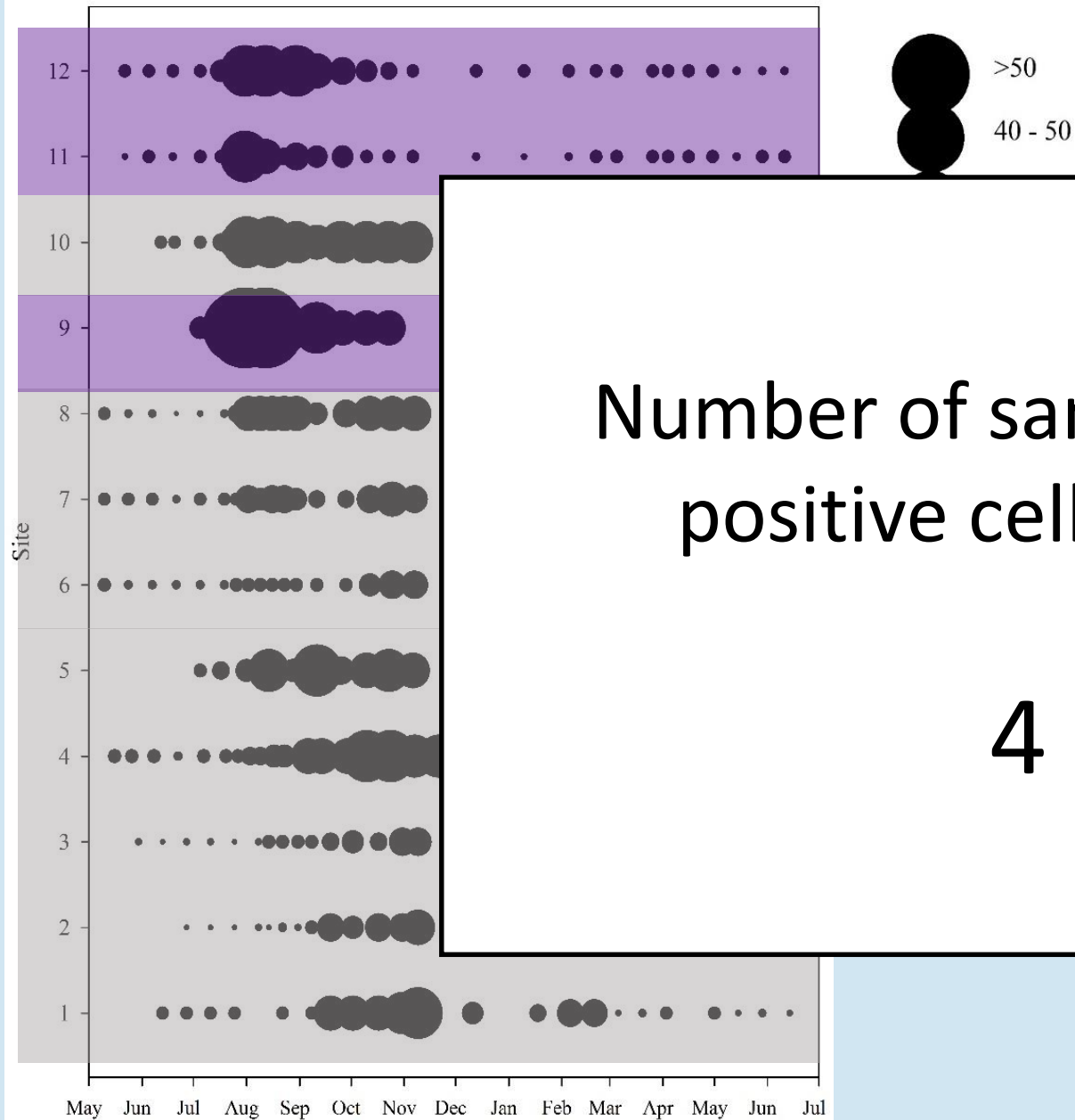




OA

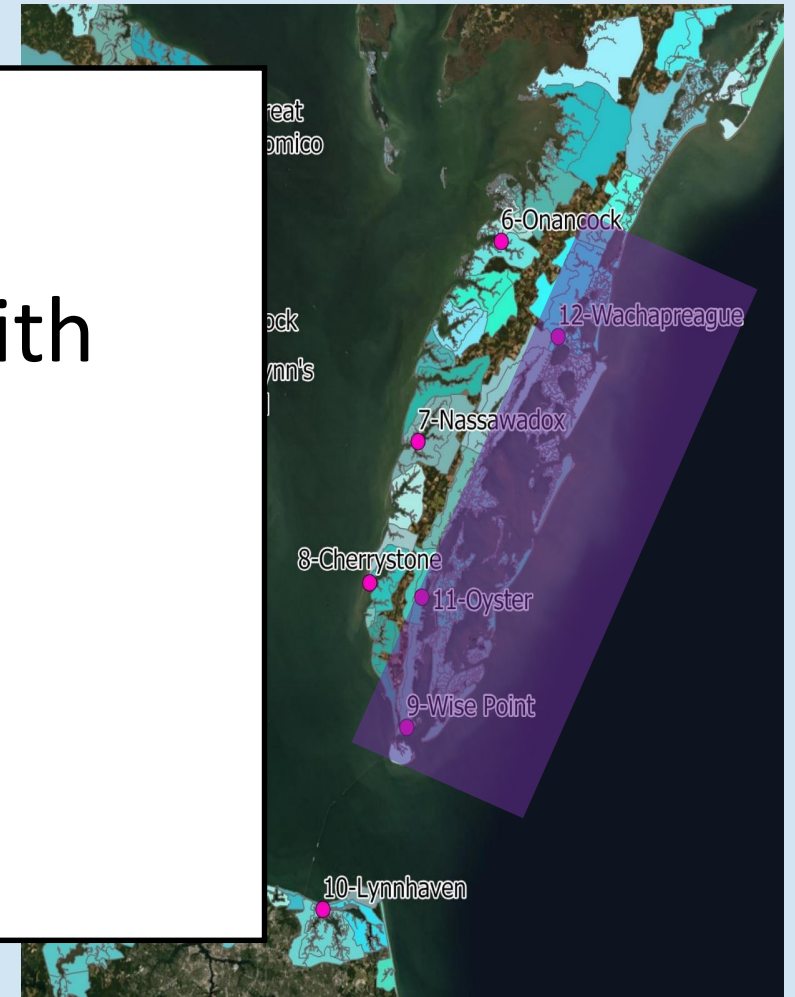


OA



Number of samples with
positive cell counts:

4

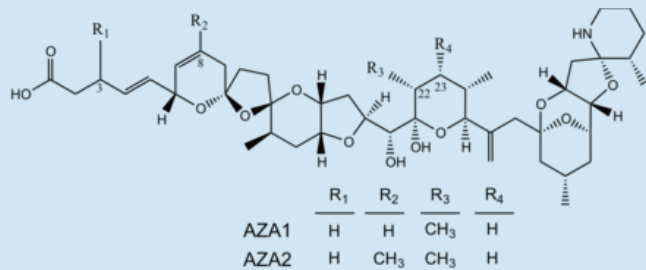


AZA2

Azadinium spp.

Amphidoma languida

Azaspiracid Shellfish Poisoning



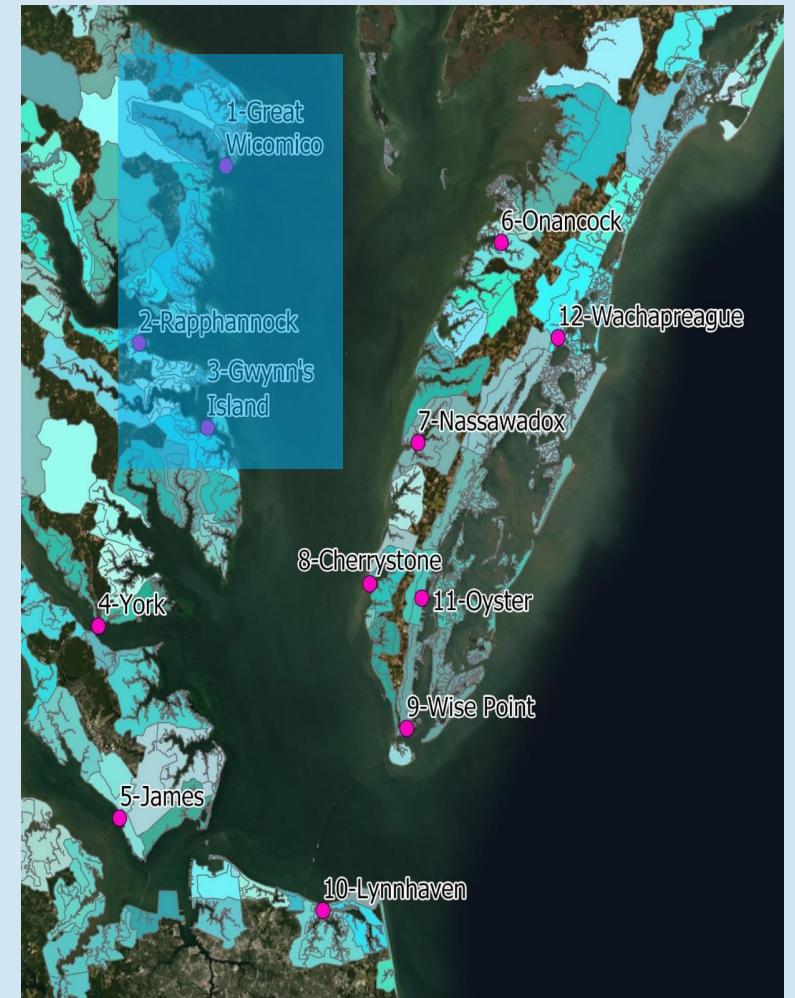
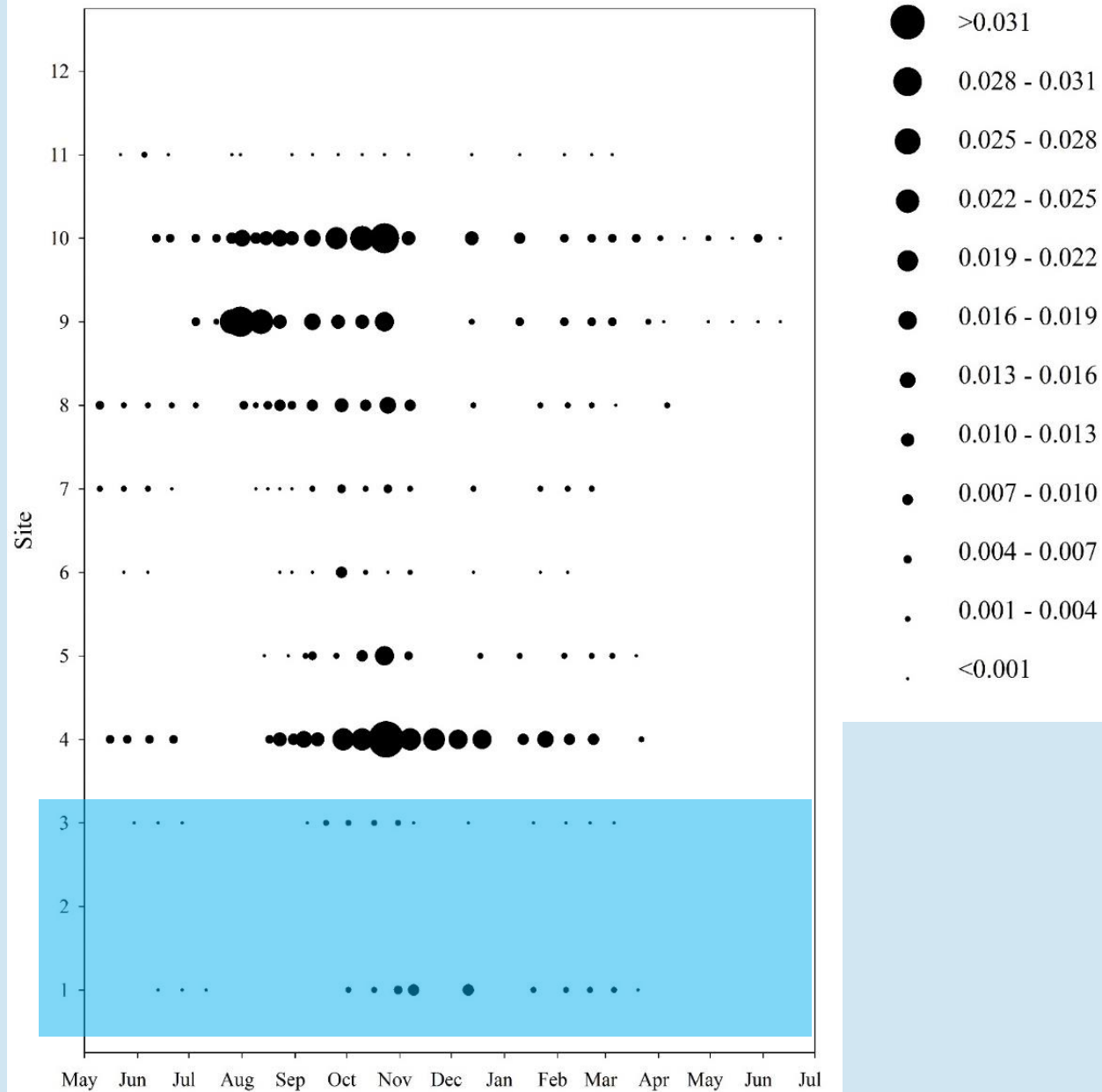
Krock et al. 2013



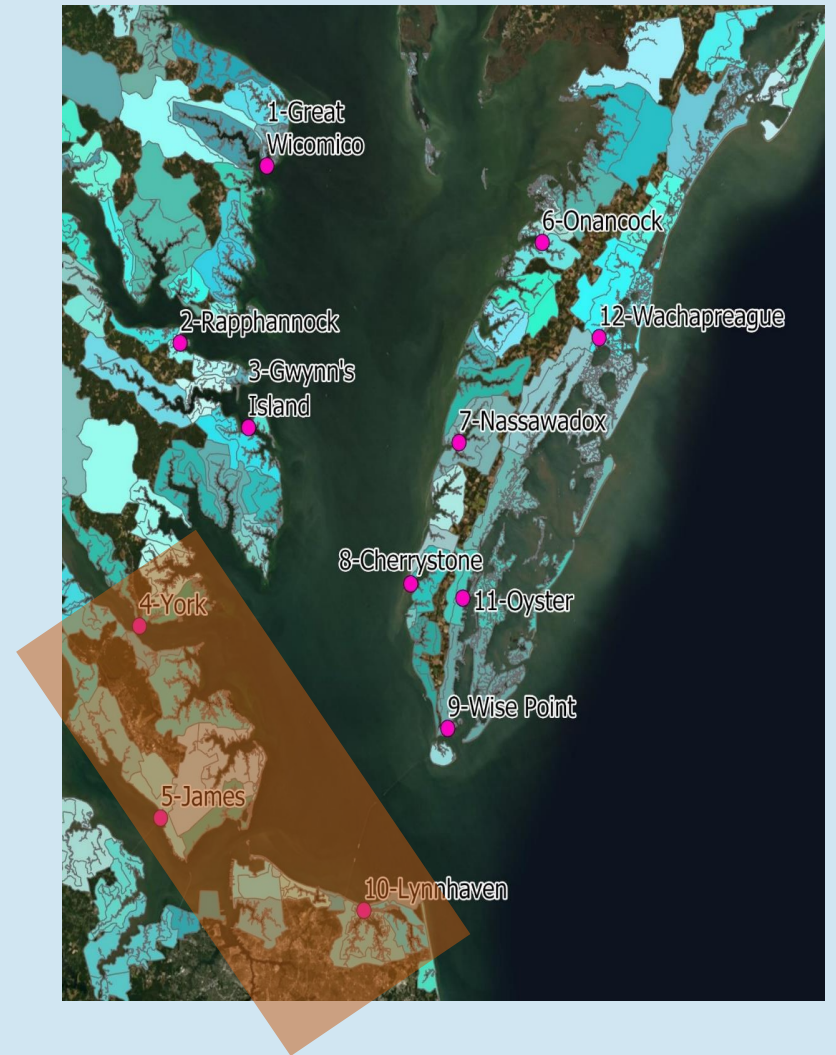
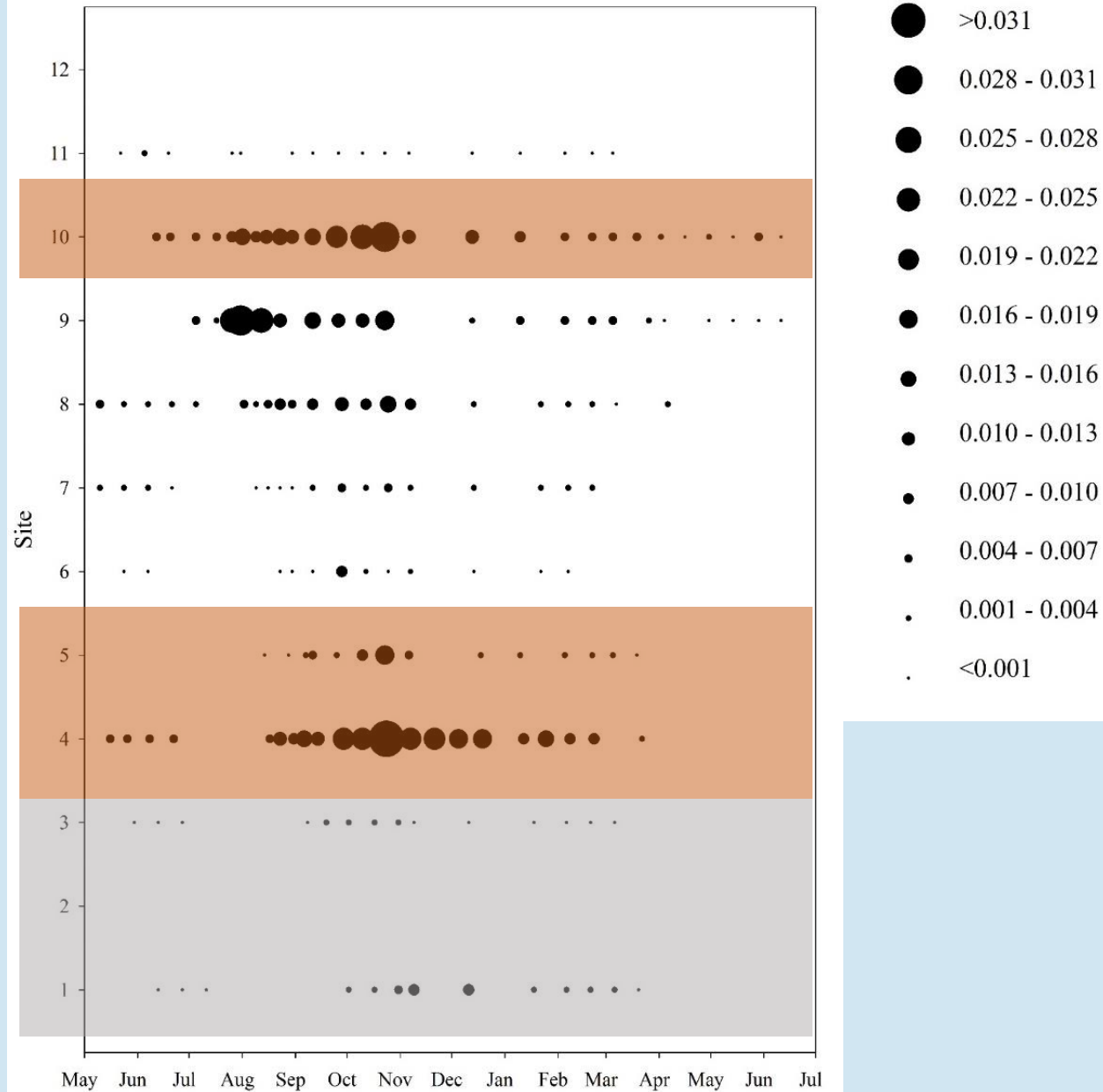
Azadinium spinosum



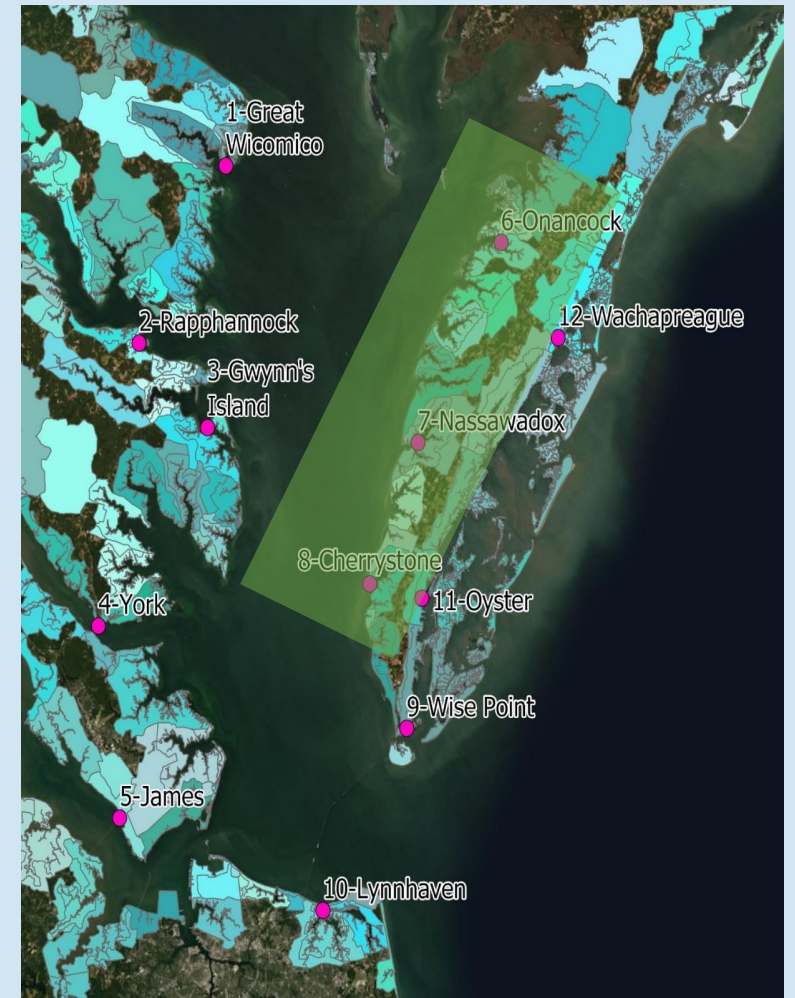
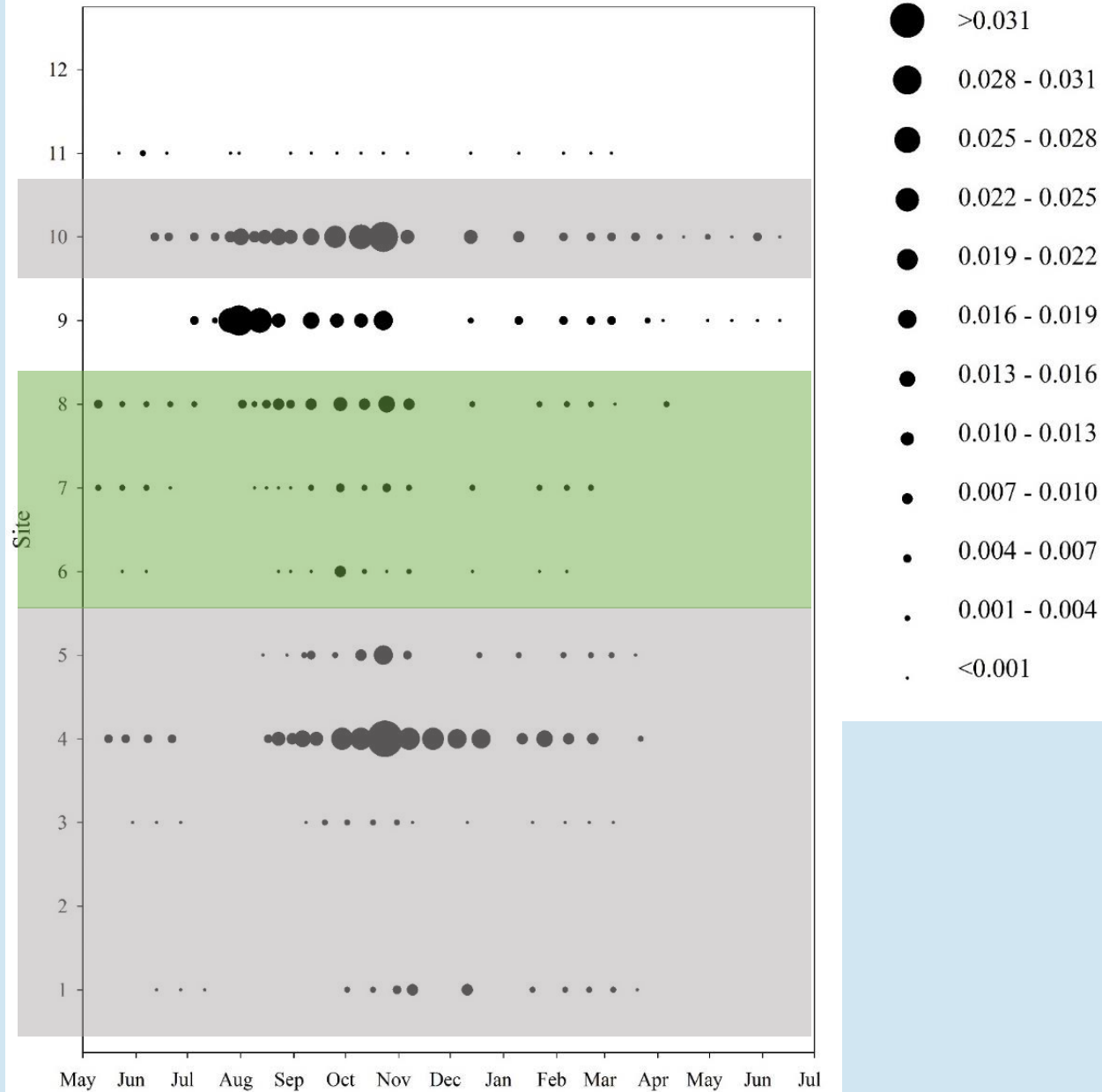
AZA2



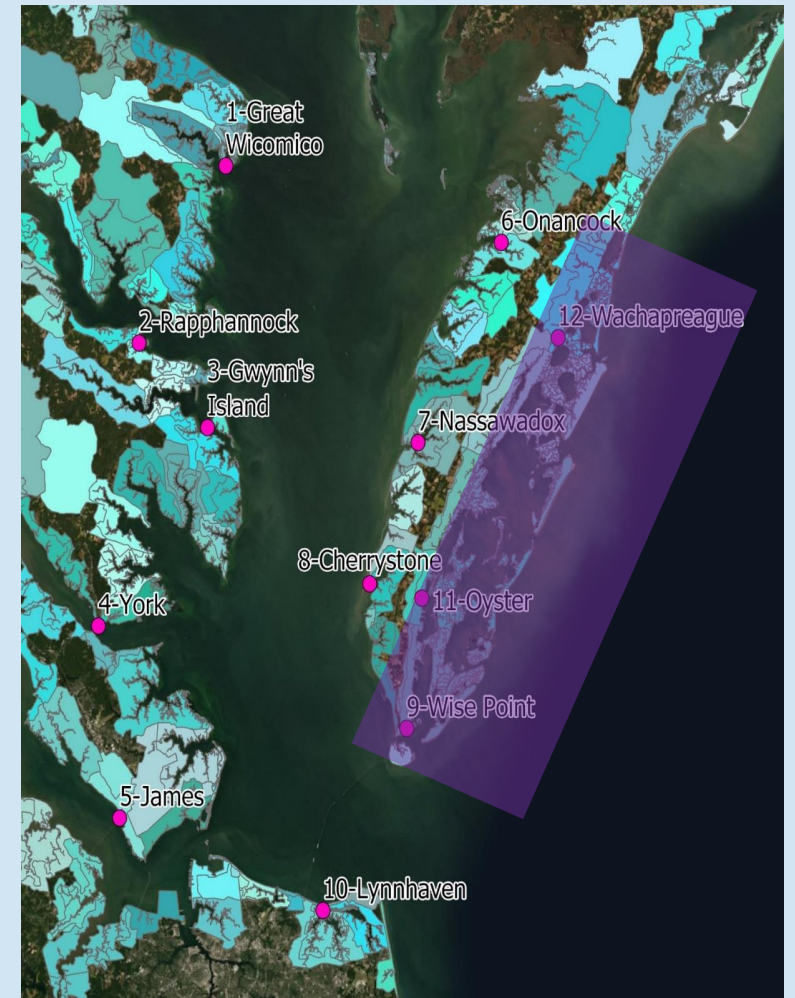
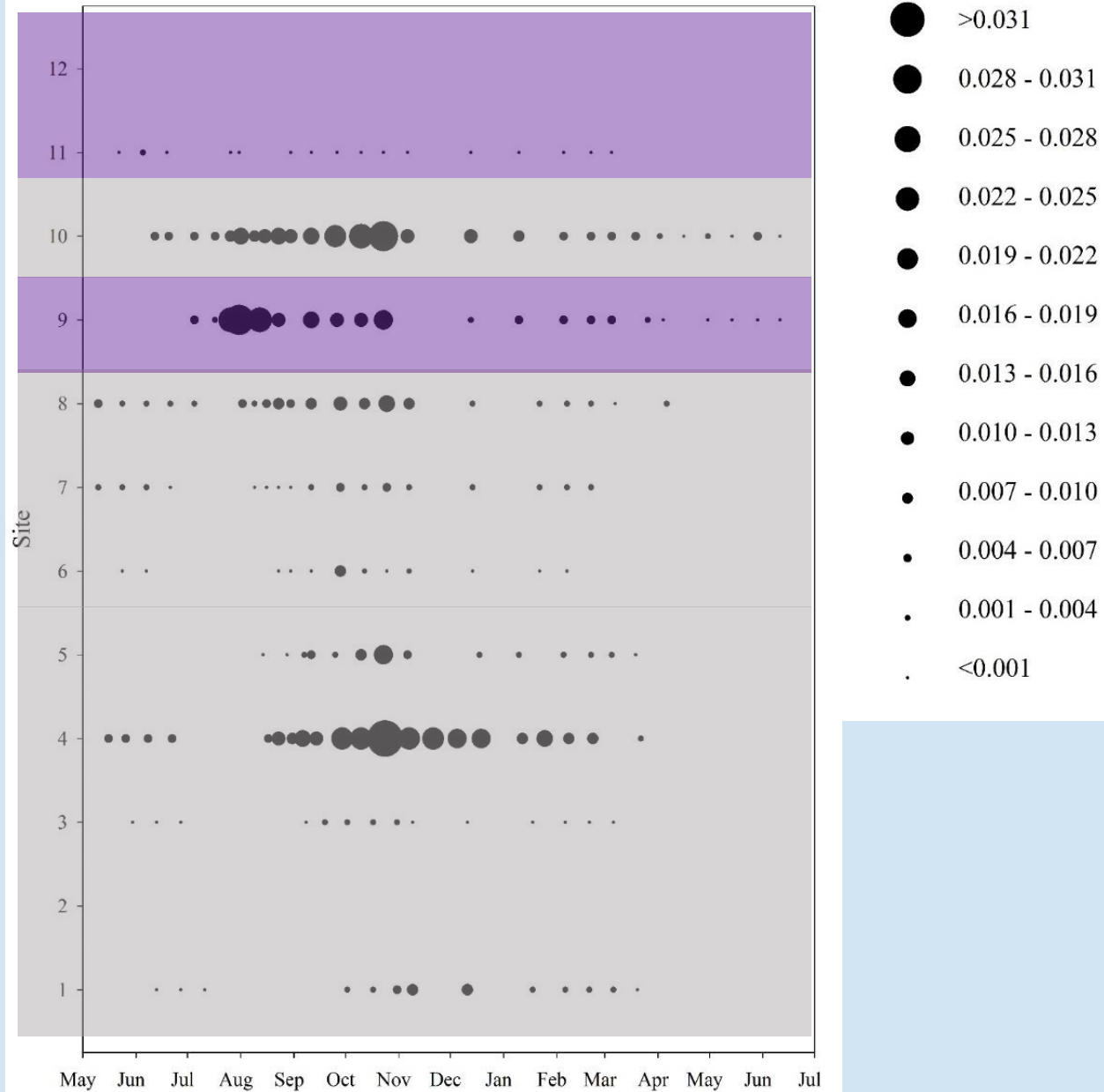
AZA2

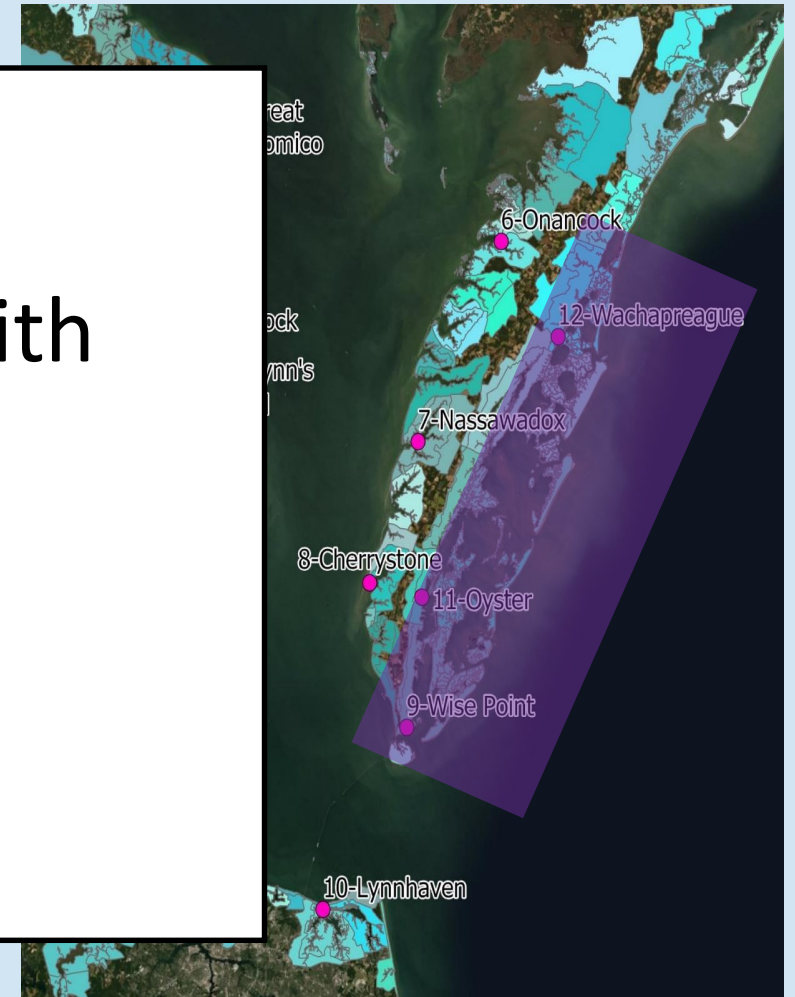
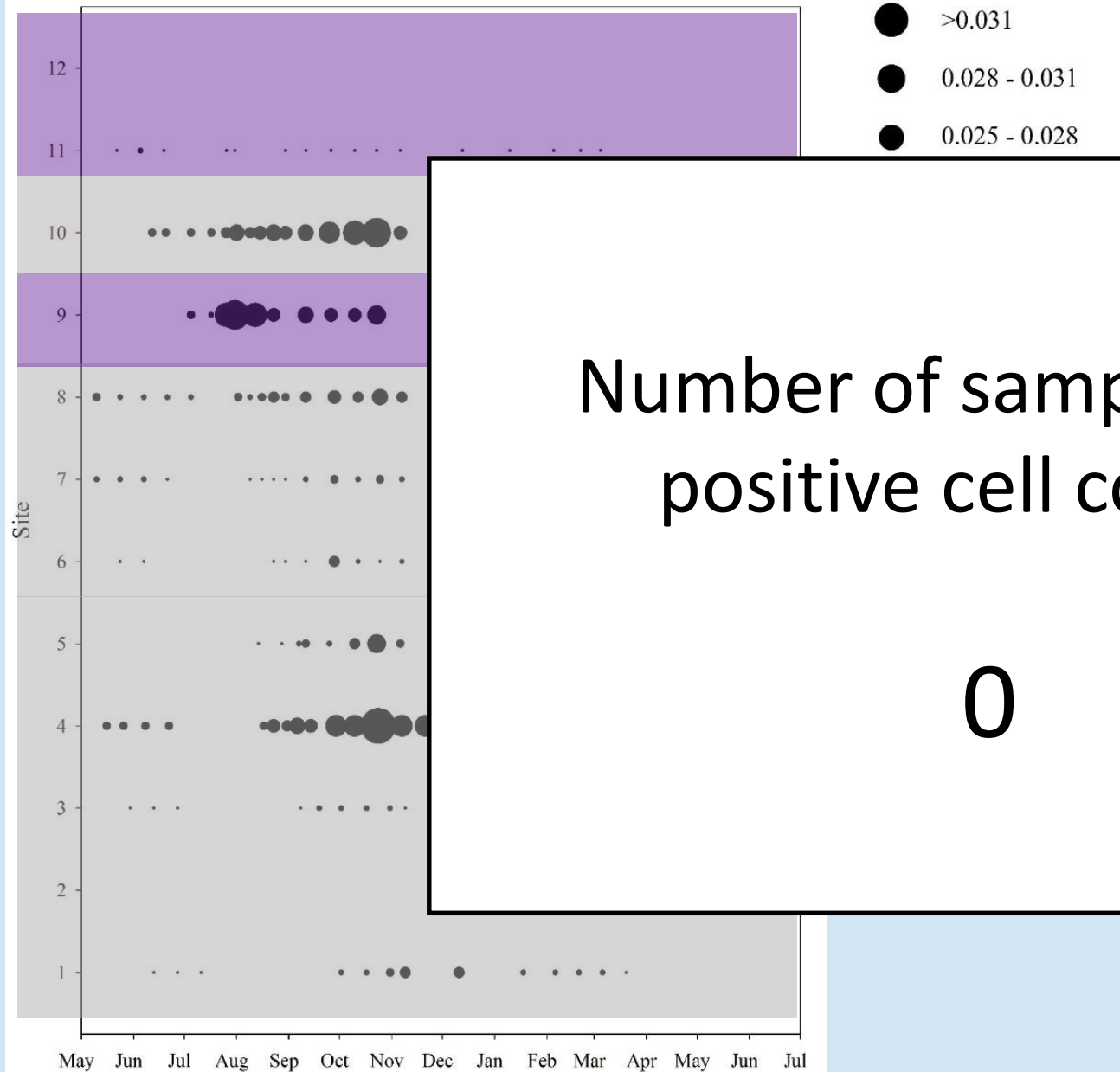


AZA2



AZA2



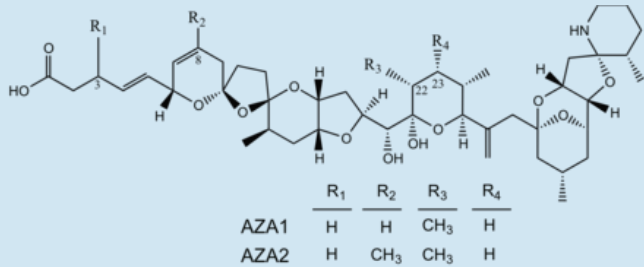


AZA1

Azadinium spp.

Amphidoma languida

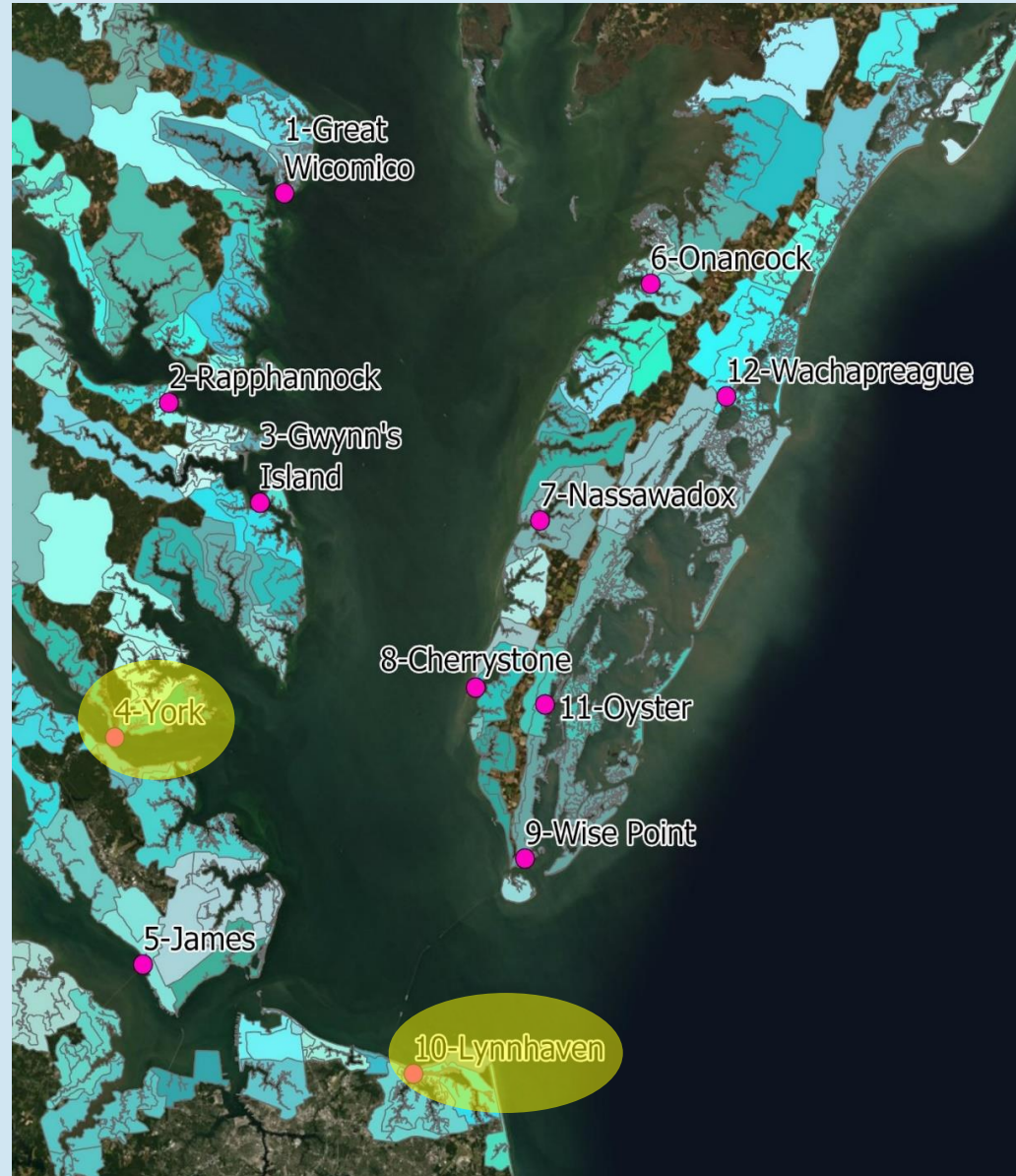
Azaspiracid Shellfish Poisoning



Krock et al. 2013



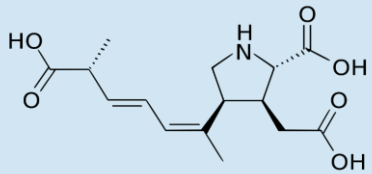
Azadinium spinosum



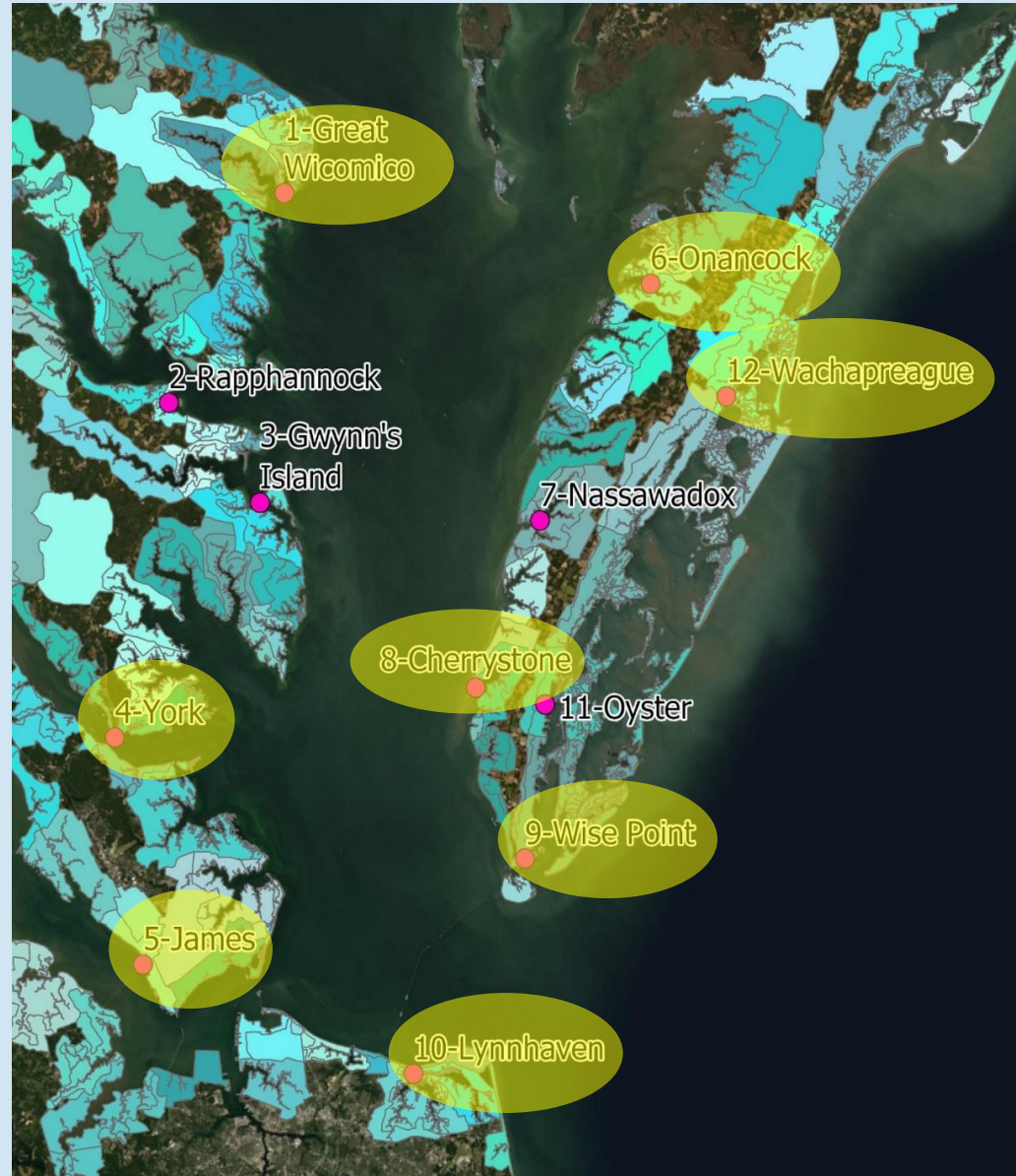
DA

Pseudo-nitzschia spp.

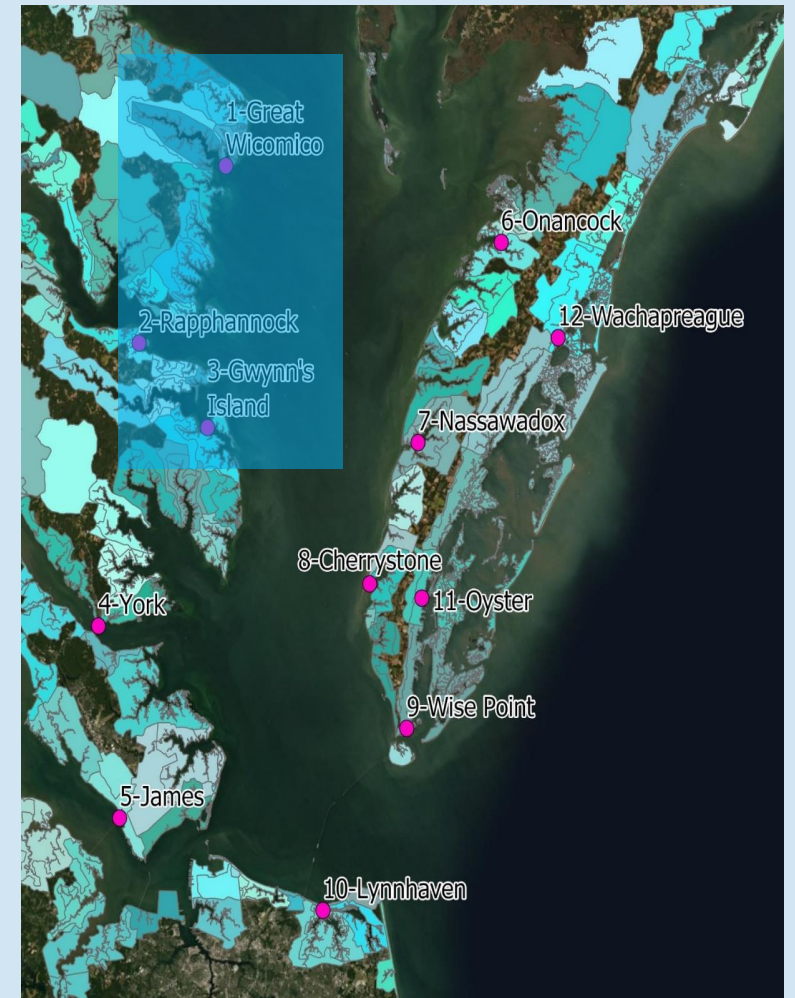
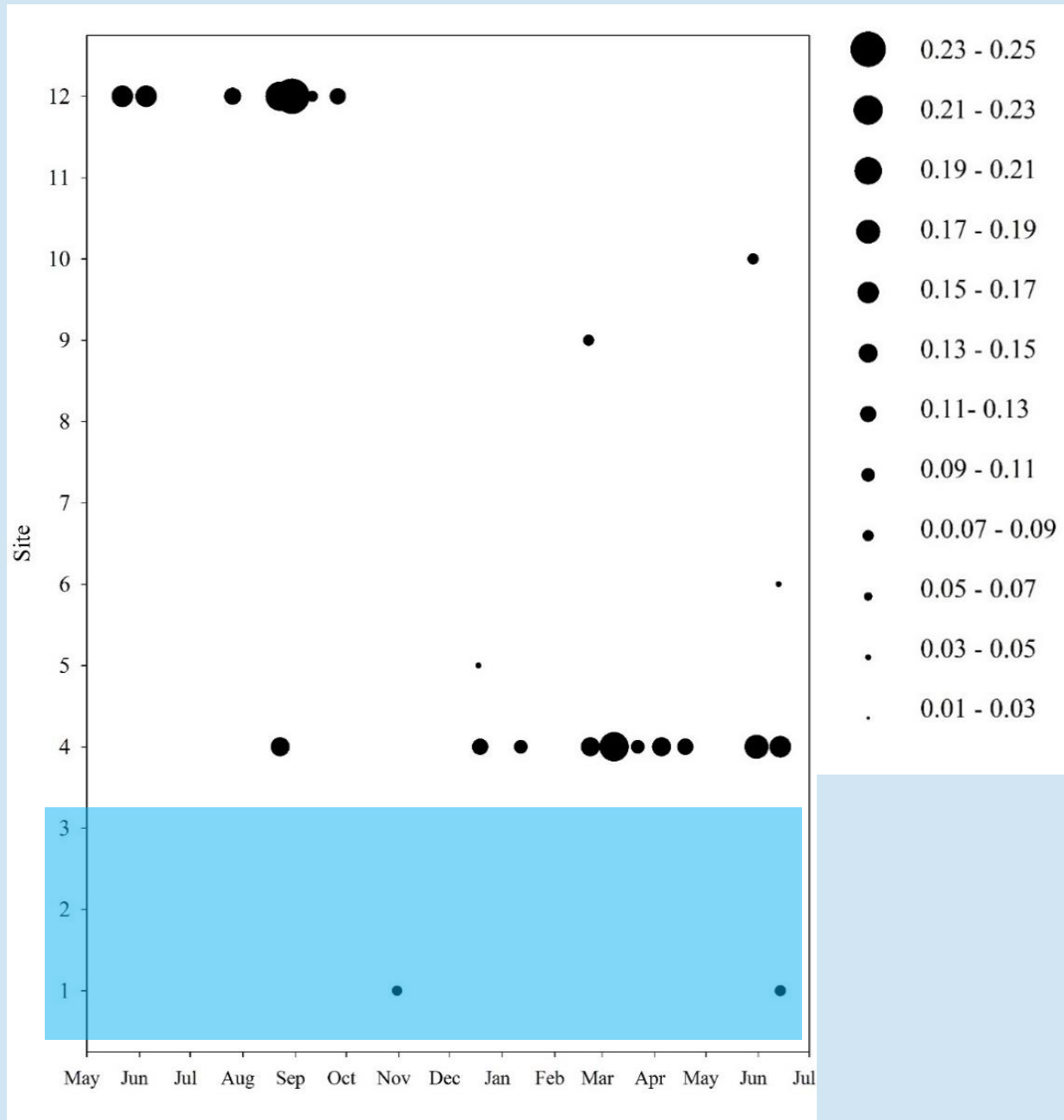
Amnesic Shellfish Poisoning



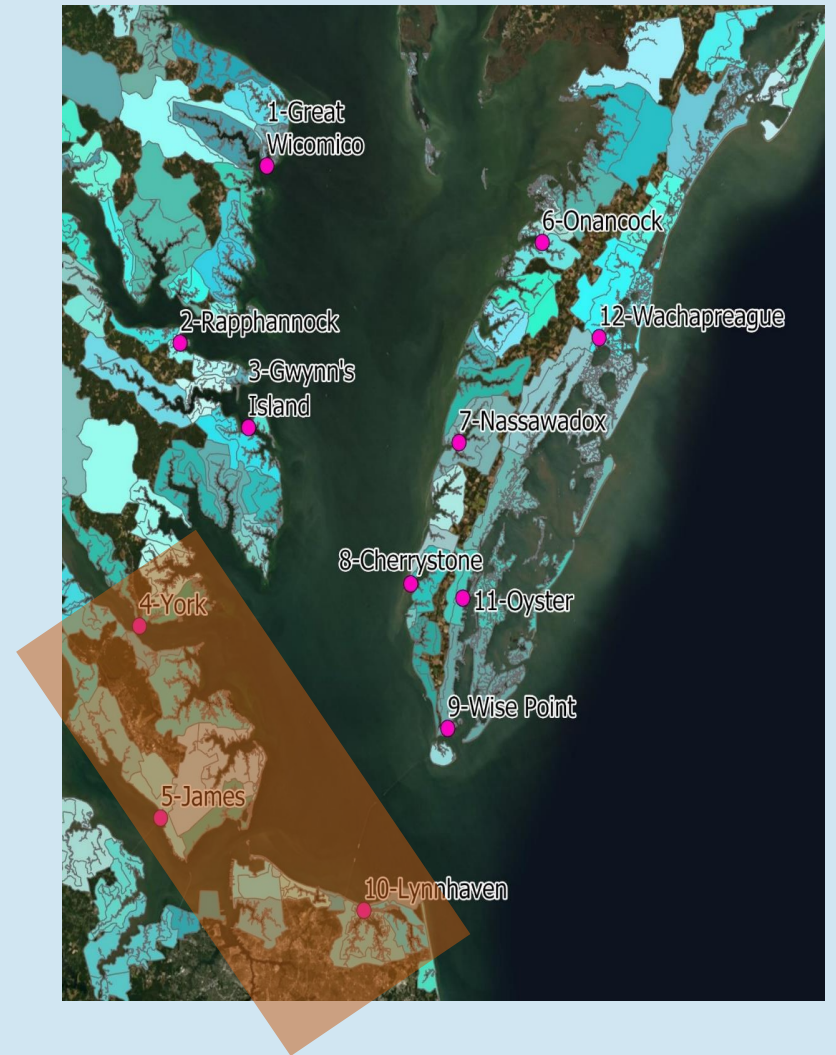
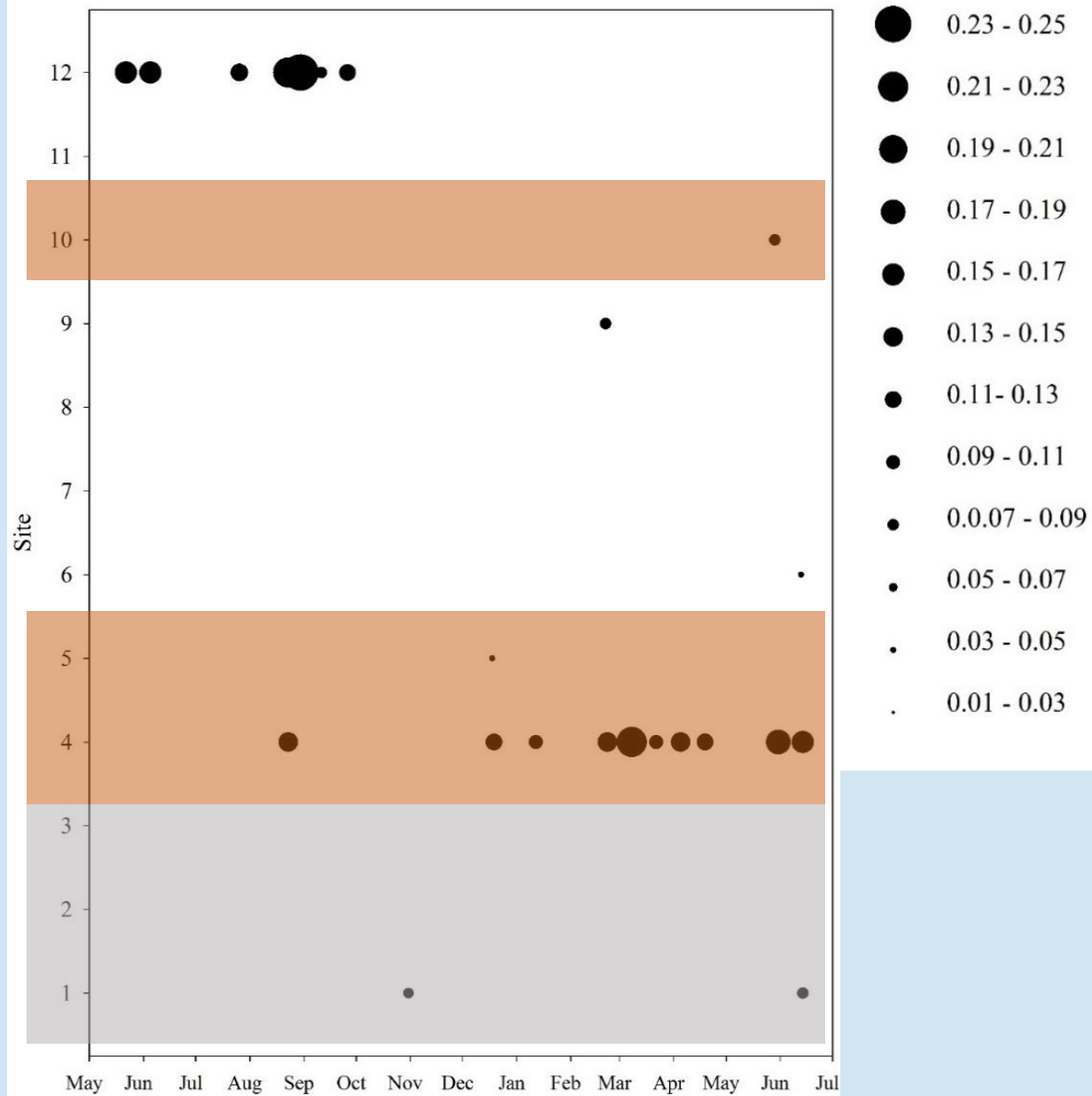
Pseudo-nitzschia pungens



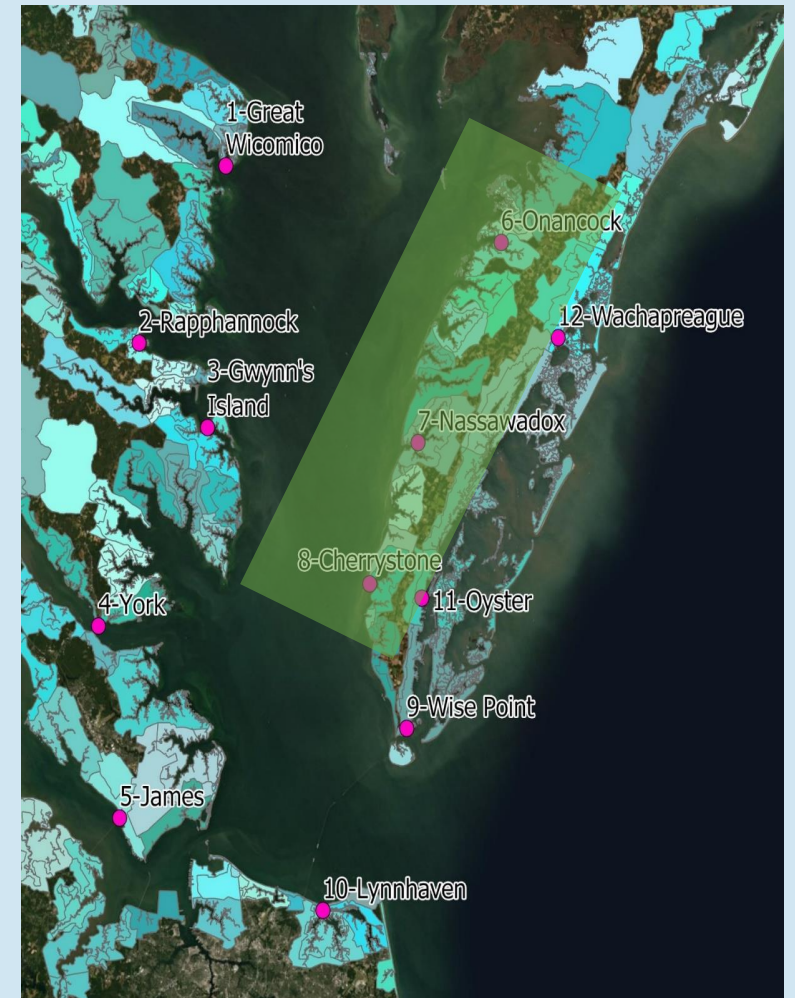
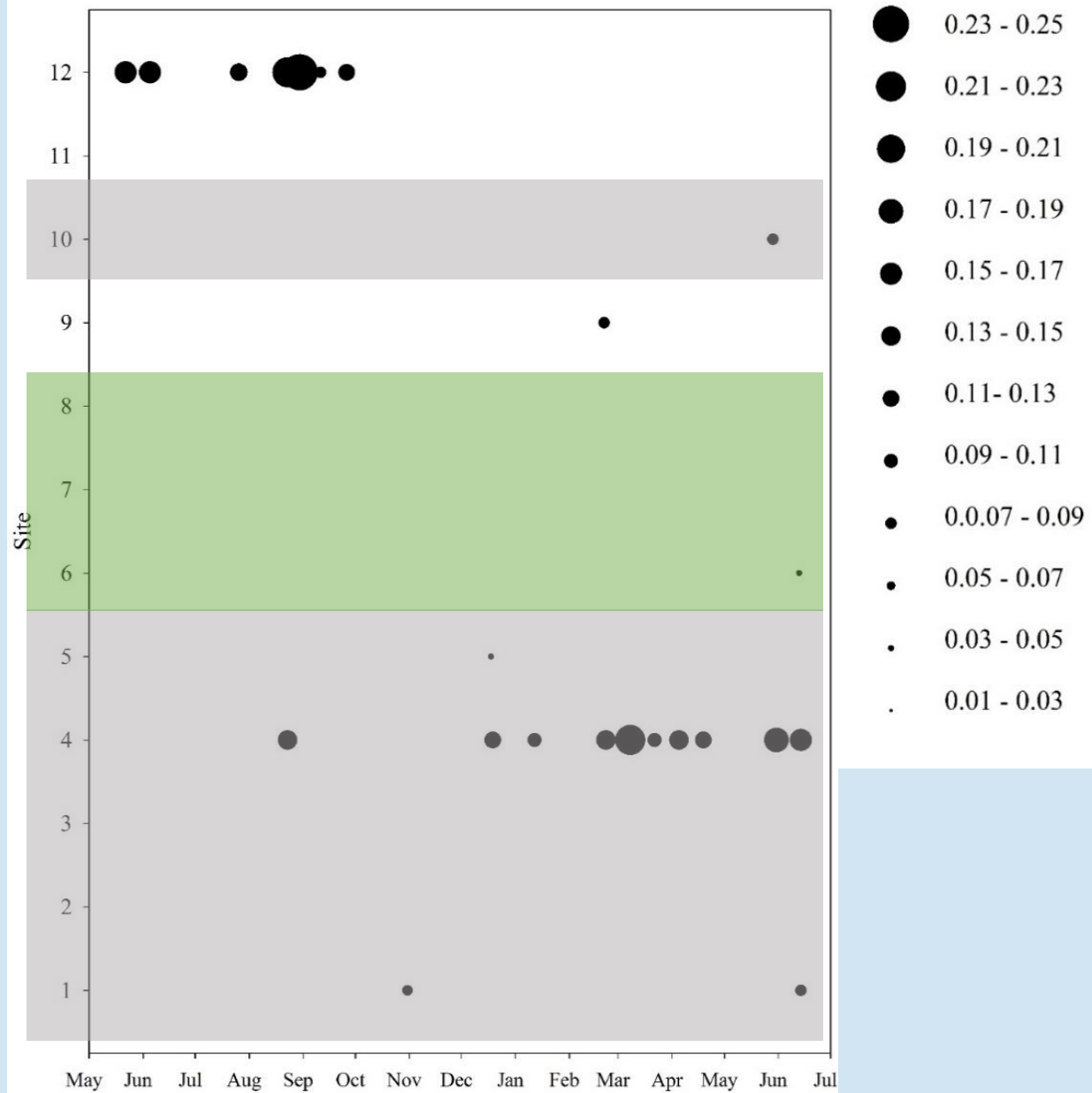
DA



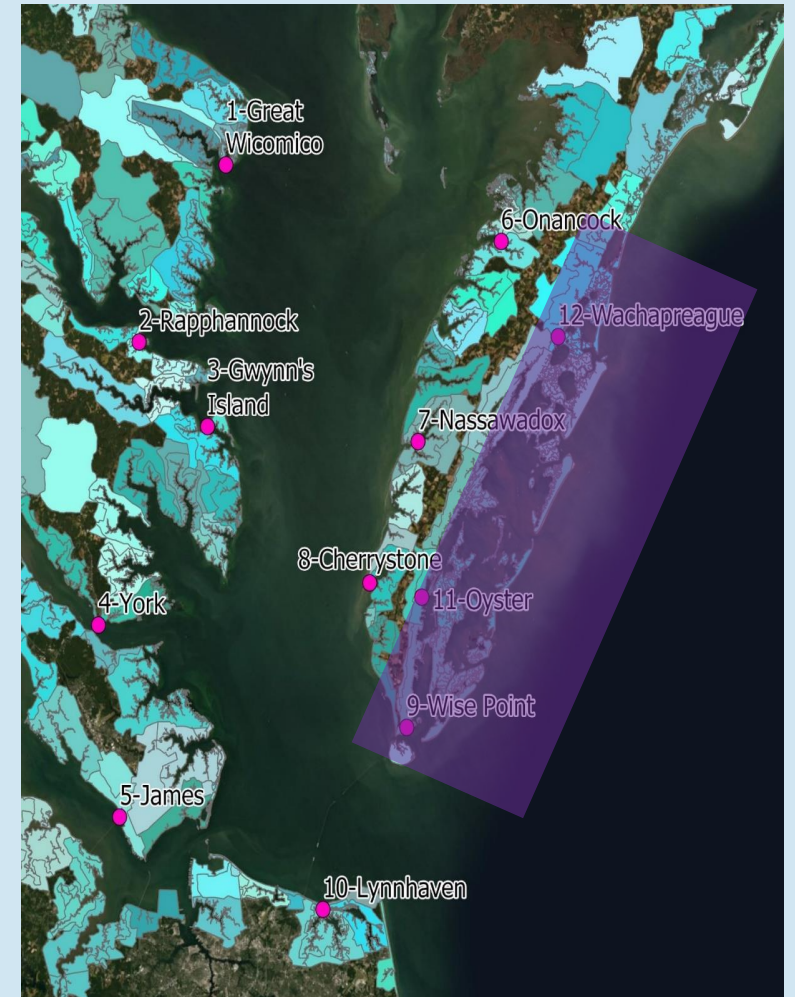
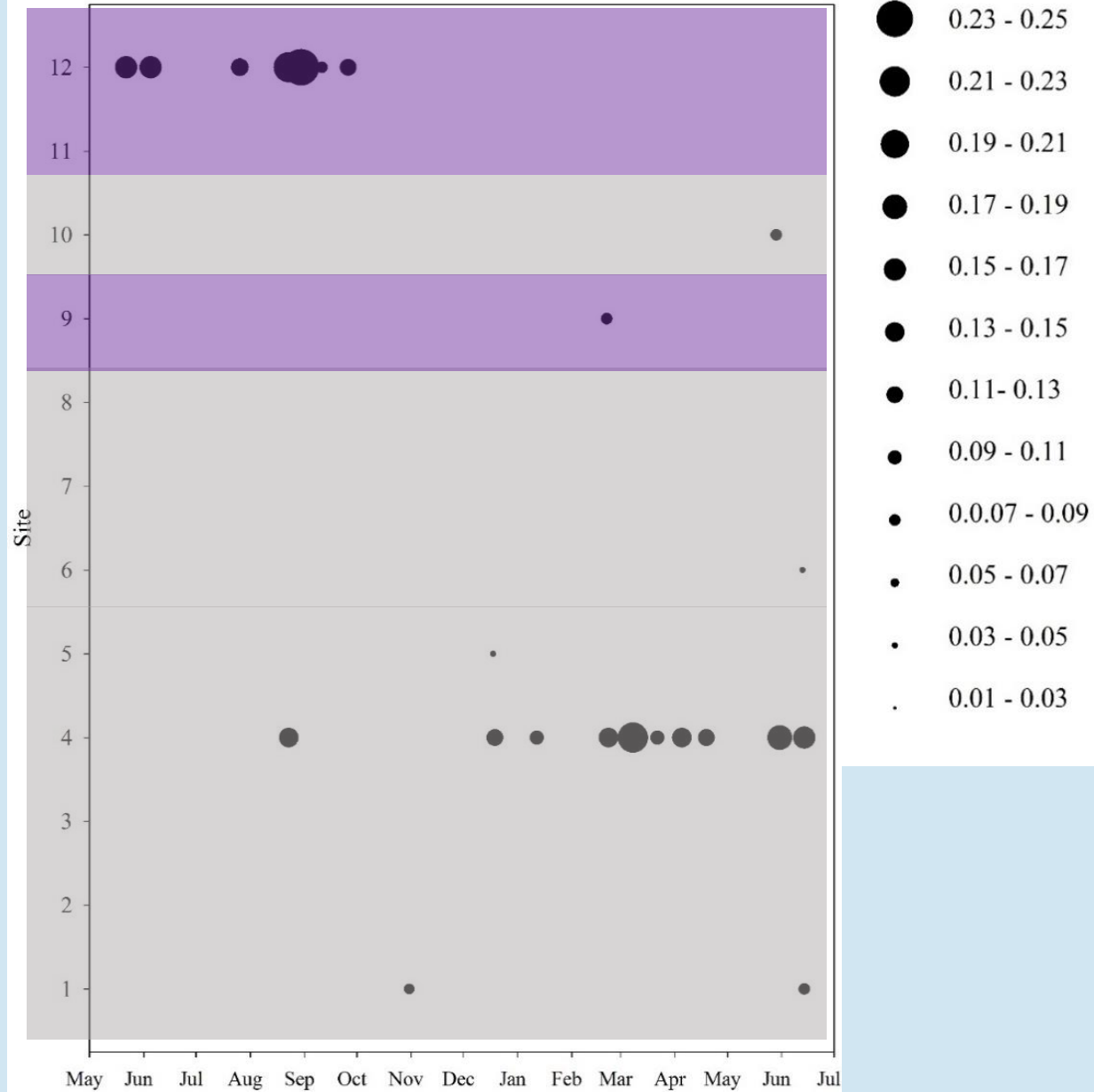
DA



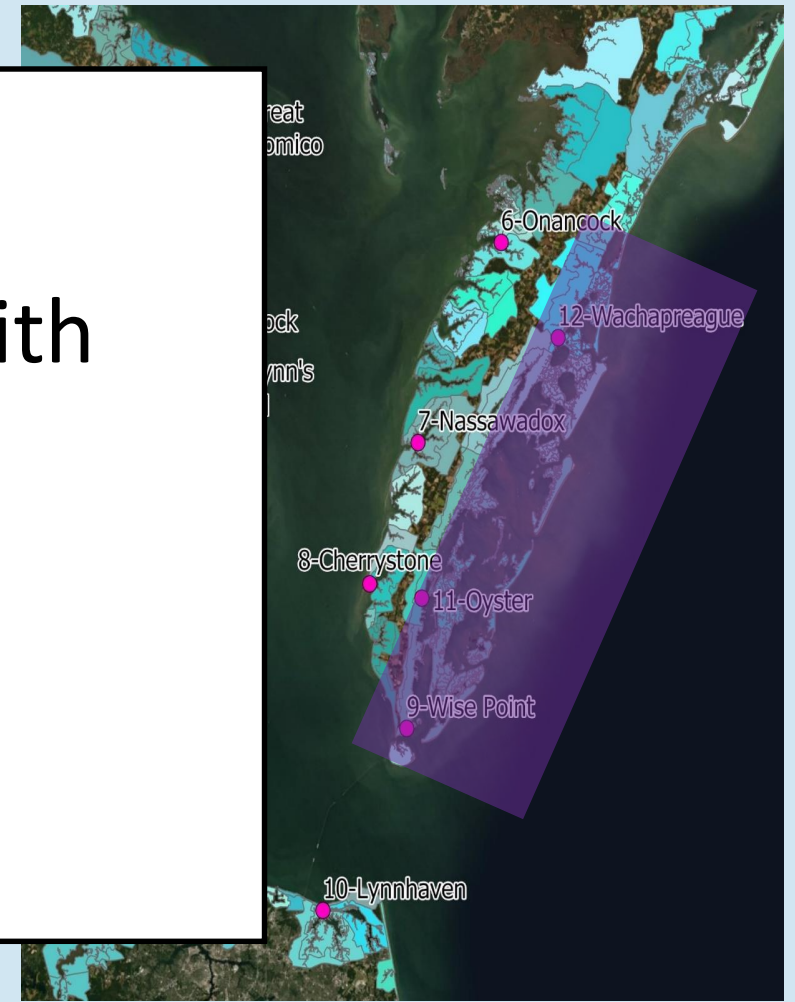
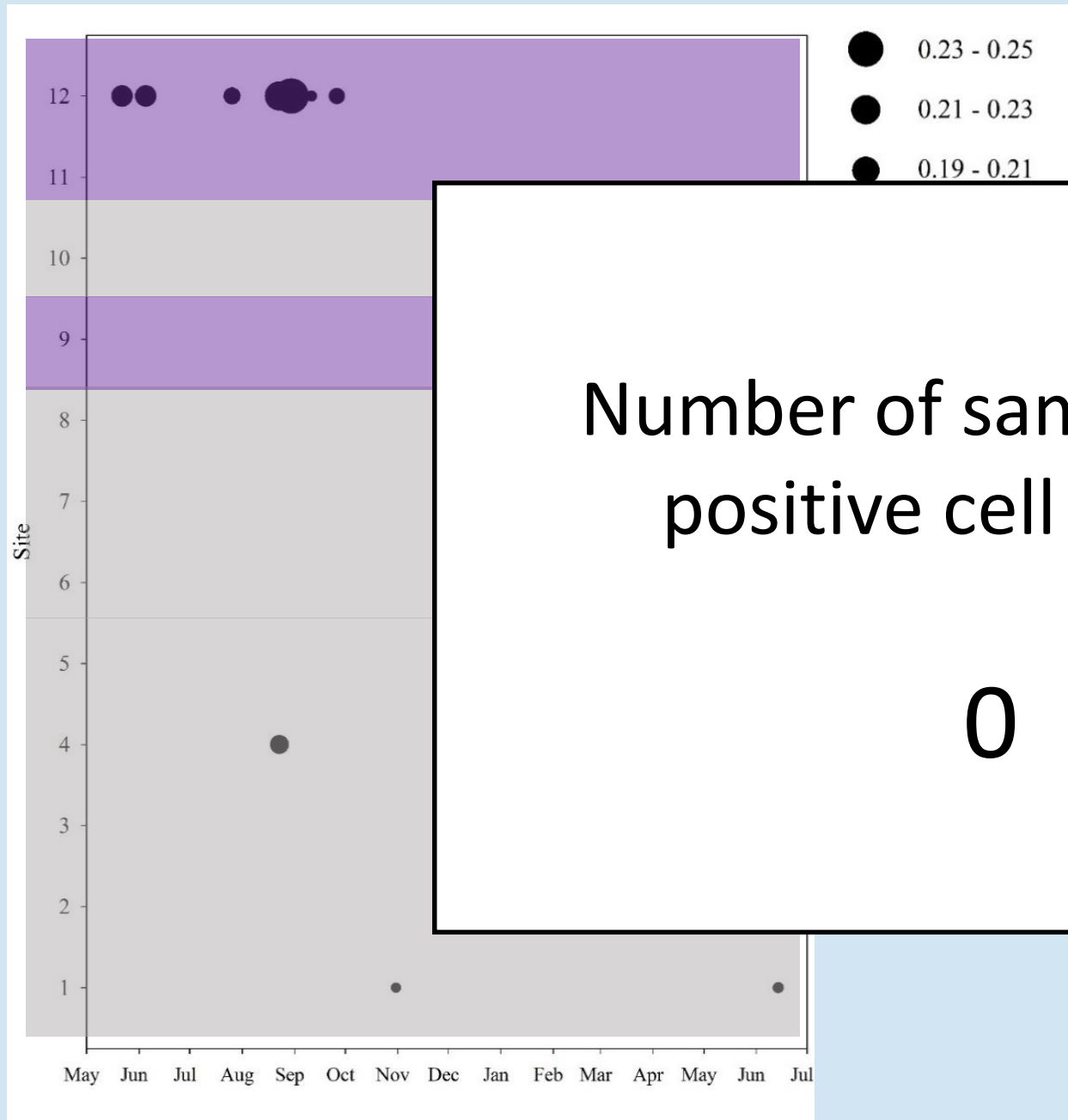
DA



DA

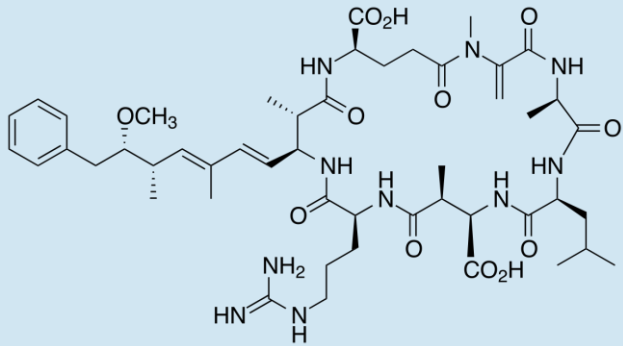


DA

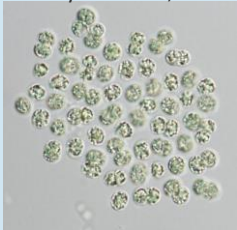


MC-LR

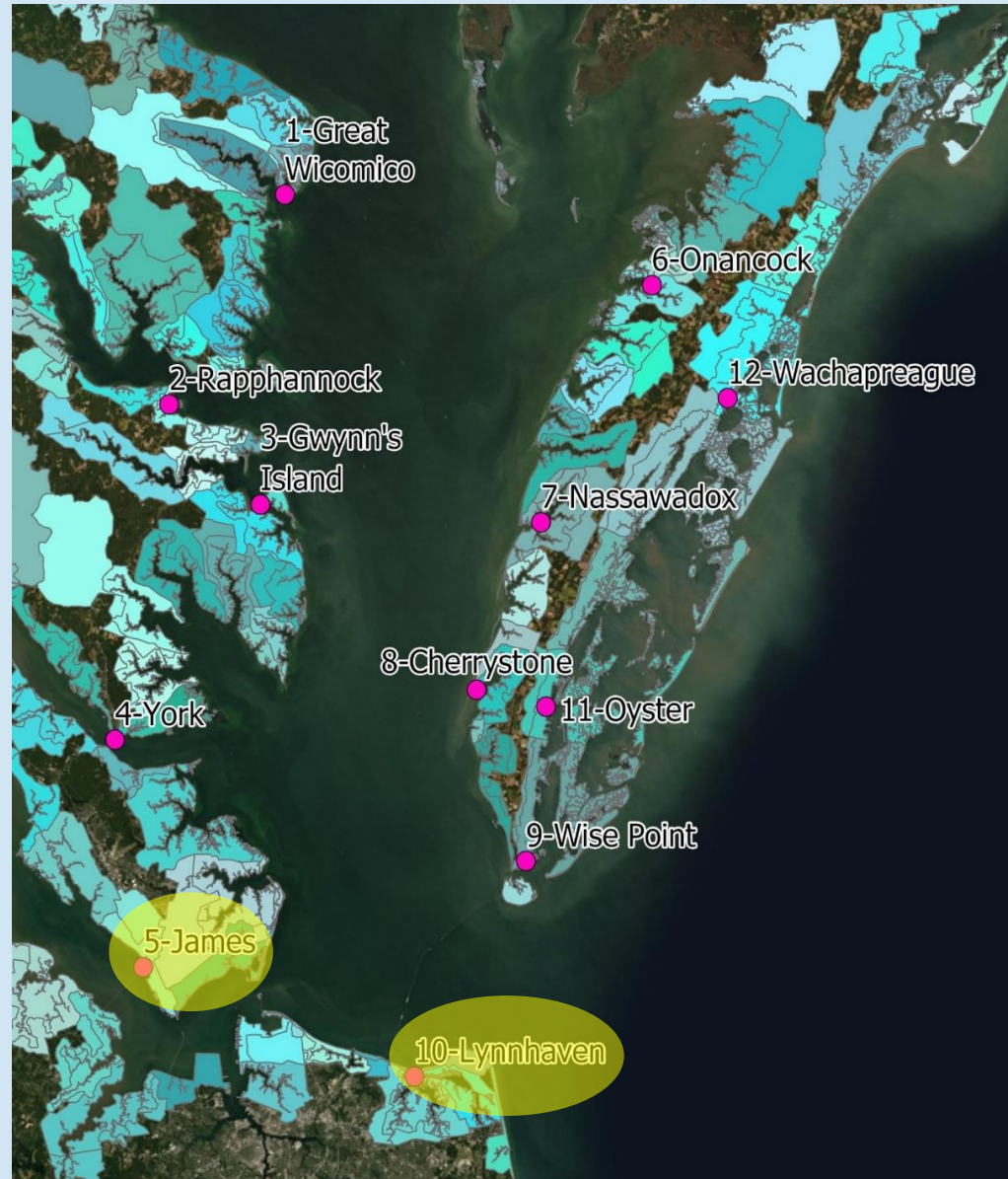
Multiple cyanobacterial species, including *Microcystis* spp.



Barry H. Rosen, USGS.

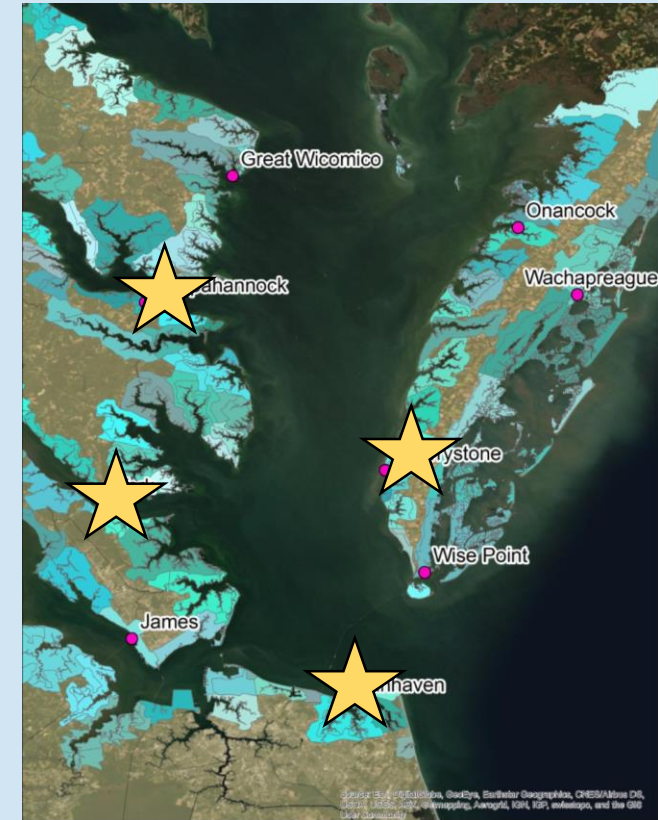


Microcystis aeruginosa



Current and Future Directions

- Oysters deployed in 2019
- Molecular techniques for *Azadinium* spp. (K. Reece, VIMS)
- Continued sampling (VDH + VIMS)
- Can we relate SPATT concentrations to water, oysters?



Acknowledgements

Funding:

NOAA Sea Grant

Smith Lab (VIMS):

Juliette Smith, Marta Sanderson, Sarah Pease, Jackie Friedman, Gao Han, Nour Ayache, I-Shuo Wade Huang, Caroline DeMent, Jeffrey O'Brien, Madison Powell

Reece Lab (VIMS):

Kim Reece, Gail Scott, Bill Jones

Virginia Department of Health:

Todd Egerton, Evan Yeargan, Adam Wood, Amanda Roach

Committee:

Allen Place, Michael Unger, William Reay

